Cent. Eur. J. publ. Health 10, 2002, No. 4, p. 174-179

MONITORING OF THE DIETARY EXPOSURE OF THE POPULATION TO CHEMICAL SUBSTANCES IN THE CZECH REPUBLIC: DESIGN AND HISTORY

Řehůřková I.
National Institute of Public Health in Prague
Centre for the Hygiene of Food Chain in Brno, Czech Republic

SUMMARY

The basic objective of the programme of monitoring the dietary exposure in the Czech Republic is to describe the character of the health risk based on the exposure of the Czech population to chemical substances in food. The conception of the monitoring programme is based on the methods of the Total Diet Study, established on the principle of defining the consumption of the most important foodstuffs, their purchase in the network of stores in selected shops on fixed dates, their transport to the central laboratory, cooking and consequent chemical analyses in the central laboratories. In the Czech Republic monitoring has been conducted since 1991/1992 and routine activities have been ongoing since 1994. The programme is fully sponsored by the government. Monitoring carried out in 1994-2001 provided a considerable amount of information, which was applied when drawing programmes of health protection and promotion, in regulatory work and when solving problems of the international food trade.

Key words: foodstuffs, monitoring, chemical substances, exposure, health risk

Address for correspondence: I. Řehůřková, National Institute of Public Health, Centre for the Hygiene of Food Chains, Palackého 1-3, 612 42 Brno, Czech Republic, E-mail: rehur@chpr.szu.cz

INTRODUCTION

In the early 1990s, the Czech Republic (CZ) (population of 10.5 million) underwent economic and social transformation. This historically highly industrialised country faced many problems associated with the contamination of the environment (1, 2) and even though agricultural production was high (3) the quality of the foodstuffs was often not quite up to the level. Liberalisation of the market and various historical problems gradually led to the establishment of a specialised monitoring system, which would evaluate the dietary exposure of the population. The system became a part of the integrated monitoring programme of the Czech government, which incorporated monitoring activities carried out by the health, agriculture and environment ministries, as well as objectives and tasks of international programmes and organisations, for instance FAO and WHO (4-6).

Within the area of health care the National Institute for Public Health Praha (NIPH), namely the Centre of Food Chain Hygiene in Brno (NIPH), was commissioned to organise the monitoring of the dietary exposure, in co-operation with the network of hygienic stations in the country. The organisation of the monitoring was laid out by government decision (7). The Czech government specified the subject area and the economic and political scope of the project. A decision was made that the system of dietary exposure monitoring would primarily not use data collected in the food control system, but that according to WHO's recommendation it would be organised after the principles of the independent Total Diet Study (TDS) (8). The basic conception of dietary exposure monitoring came into being in 1991/1992 and was based on partial national, but particularly international, experience. Information obtained in the TDS and organised by the FDA USA (9-13), the TDS organised by the Health and Welfare Canada (14), the Market Basket Study conducted in Australia (15) were taken as the groundwork, and naturally experiences from a number of European countries (16-20). In the course of the 1990s the design of the programme was developed and changed. The objective of the present publication is to describe the design and history of the programme of dietary exposure monitoring based on the Total Diet Study methods in the Czech Republic in 1994-2001.

The Objectives of the Programme of Dietary Exposure Monitoring

The essential objective of the programme of dietary exposure monitoring is to describe the health risk resulting from an exposure of the Czech population to chemical substances in food. The results should be applicable as scientific data for decision-making procedures in the area of Czech health policy, for orientation purposes of the food control system and for the introduction of regulation limits. An important objective is to keep the professional and laic public well informed on a regular basis. At the same time the results should be used in international co-operation, for instance in communication with EU, OECD, FAO/WHO, and also with WTO.

Characterisation of the Health Risk Based on the Results of Monitoring

The characterisation of the health risk is based on the assessment of the exposure of the population to chemical agents (21-24). The monitoring programme is based on two principal components of assessment of the exposure. The first

is the assessment of the average daily consumption (or availability) of foodstuffs in the population. Beside this specific method of assessment may be based on recommended daily food portions for defined groups of the population. The other component is the assessment of the concentration of chemical substances in the foodstuffs.

DESIGN AND HISTORY OF THE MONITORING PROGRAMME

The methods of the Total Diet Study applied in the Czech Republic are based on the principle of definitions of the consumption of the most important foodstuffs, their purchase in the network of stores in specified places on fixed dates through one year, their transport to the central laboratory, cooking and the following chemical analyses in the central laboratories. The programme is fully sponsored by the government.

Selection of the Network of Monitoring Places

The monitoring places were selected in such a way as to meet the given criteria. One of the most important criteria for the selection was the even distribution of places over the country (at least three places in one quadrant of the country, see Fig. 1), balanced representation of places with different levels of environment contamination (25), and the presence of a state hygienic station with skilled specialists. In total, 12 places were incorporated in the monitoring network.

Assessment of Food Consumption in the Population

The household budget survey methodology (26-28), which is suitable for the assessment of the chronic exposure on a national level, was used in the Czech Republic to assess the food consumption for the so-called "reference person" per day. In co-operation with the Czech Statistical Office three separate studies were conducted in the 1990s elaborating questionnaire data on food consumption in 1991, 1994 and 1997 (29-31). The result of the analysis was a definition of the average consumption of approximately 500 commodities for the reference person (average weight 64 kg = integral of the lifespan weight of the Czech population) per day. In terms of consumption the most important foodstuffs were selected for sampling purposes. For long-term comparisons of exposure doses to chemical substances independent of changes in consumption we used the model of standardised food consumption (so-called "food pyramid") recommended for 5 population groups: 4-6 year-old children, adult males over 18 years of age, adult females over 18 years of age, pregnant and nursing women and elderly individuals of 60 years and over (32).

Food Sampling in 1994-1998

On the basis of information on the consumption and present results of food controls, 160 of the most frequently consumed commodities were selected for analytical studies in the course of each calendar year. The complete set of 160 food samples were purchased by the trained staff of hygienic stations in the network of stores in every of 12 places of the country, evenly on 5 dates during each year, considering the season. After collection the samples were immediately transported to the central place where they were processed and analysed (NIPH Brno). In terms of the number of analysed samples the real potential limited by the budget was achieved by combining related commodities into so-called composite samples and so-called representative composite samples. By mixing we prepared 46 composite samples from the 160 commodities, each representing one place. Every year 552 composite samples were analysed (46 x 12 places), which represented 1920 individual food samples purchased in the country network of stores. The so-called representative composite samples were used as an average samples for the Czech Republic and were prepa-

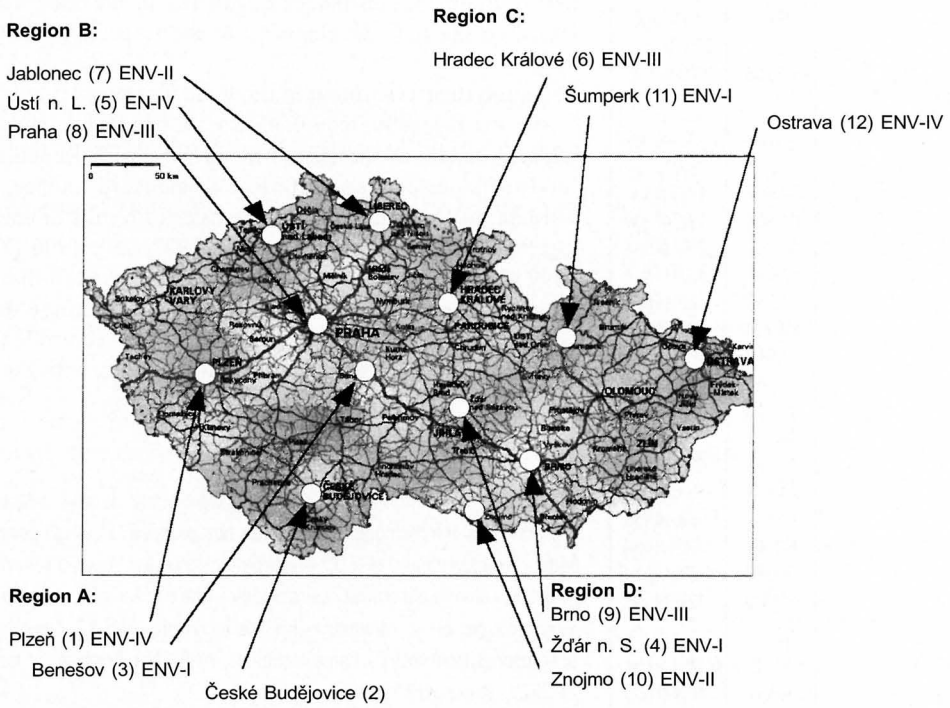

Fig. 1. The network of sampling places divided into regions in the Czech Republic
Legend: Plzeň - name of sampling place; (1) - number of sampling place used in database; ENV-IV - environment pollution level.

Table 1. Chemical substances analysed in the dietary exposure monitoring in the Czech Republic during 1994 - 2001

Analyt	Analytical method	Period of investigation
Organochlorine pesticides:		
Aldrin	GC-2xECD	1994-till now
DDD24, DDD44, DDE24, DDE44, DDT24, DDT44	GC-2xECD	1994-till now
Dieldrin	GC-2xECD	1994-till now
Endrin, Endrinketon	GC-2xECD	1994-till now
Endosulfan I, Endosulfan II, Endosulfan sulfate	GC-2xECD	1994-till now
Hexachlorbenzene	GC-2xECD	1994-till now
Hexachlorcyklohexan alpha, beta, delta, gamma	GC-2xECD	1994-till now
Heptachlor, Heptachlor epoxide A, B	GC-2xECD	1994-till now
Methoxy chlor	GC-2xECD	1994-till now
Indicator congeners PCB:		
PCB 28,52, 101, 118, 138, 153, 180	GC-2xECD	1994-till now
Substances with TCDD effect:		
Toxic congeners PCB:		
PCB 77,126,169,105,114,118,123,156,157,167,189,170,180	GC-2xECD	1997-till now
	GC-MS	2000-till now
Dioxins:		
2378TCDD, 12378PeCDD, 123478HxCDD, 123678HxCDD, 123789HxCDD, 1234678HpCDD, OCDD	GC-MS	2000-till now
Furans:		
2378TCDF, 12378PeCDF, 23478PeCDF, 123478HxCDF, 123678HxCDF, 234678HxCDF, 123789HxCDF, 1234678H CDF, 1234789HpCDF, OCDF	GC-MS	2000-till now
Polycyclic aromatic hydrocarbons:		
Benzo(a)pyrene, Dibenzo(ah)anthrecene,Benzo(a)anthrecene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Ideno(123cd)pyrene, Anthracene, Benzo(gh)perylene, Chrysene, Fluoranthne, Phenanthrene, Pyrene	HPLC	1996
Carbamate pesticides:		
Aldicarb, Aldicarbsulfoxide, Aldicarbsulfone, Methomyl, Oxamyl, 3-hydroxycarbofuran, Carbaryl, Carbofuran, Propoxur, Pirimicarb, Methiocarb	HPLC	2000
Mycotoxins:		
Aflatoxin B1, B2, G1, G2, M1	HPTLC	1994-1996 2000-till now*
Ochratoxin A	HPTLC	2000-till now*
Elements:		
Cadmium	AAS-GF	1994-till now
Lead	AAS-GF	1994-till now
Chromium	AAS-GF	1995-till now
Nickel	AAS-GF	1995-till now
Aluminium	AAS-GF	1997-till now
Arsenic, Arsenic total	AAS-HT	1994-till now
Selenium	AAS-HT	1994-till now
Mercury	AAS-AMA	1994-till now
Copper	AAS-FT	1994-till now
Manganese	AAS-FT	1994-till now
Zinc	AAS-FT	1994-till now
Magnesium	AAS-FT	1995-till now
Potassium	AAS-FT	1996-till now
Sodium	AAS-FT	1996-till now
Calcium	AAS-FT	1996-till now
Iron	AAS-FT	1997-till now
Phosphor	SPEFO	1996-till now
Iodine	SPEFO	1998-till now
Anions:		
Nitrate	HPLC	1994-till now
Nitrite	HPLC	1994-till now
Vitamins:		
Vitamin C	HPTLC	1997

red by mixing composite samples of the same kind from all the 12 places into only one sample (46 samples / country / year). This type of samples was used for orientation analyses or for special chemical analyses.

Food Sampling in 1999 - 2001

Basing on conclusions of 5 years of monitoring, important information was drawn in 1998. In statistical terms it had not been possible to prove the differences in exposure doses from commercially available foodstuffs for the places of collection, which had originally been selected according to the different level of environment contamination. Within the framework of the whole country the exposure dose from commercial foodstuffs sold on the market did not differ statistically. The food market is not very large and most of the more important foodstuffs are traded over the whole country. This fact enabled to modify the concept of sampling in order to increase the number of analysed commodities to the detriment of the number of analysed collection places. Since 1999 a new concept of sampling has been applied. The set of food samples delivered for chemical analysis consists of 195 individual foodstuffs selected on the basis of food consumption in 1994 (30) and 1997 (31). The 12 original collection places were divided into 4 regions of the Czech Republic, i.e. A, B, C and D (Fig. 1). Every year a total number of 2340 food samples were collected. The food samples from three places of one quadrant of the country were mixed to make regional samples and they were combined into 108 so-called composite samples from each region and year. In this way 432 composite samples are supplied for analyses every year. To determine some of the chemical substances, the composite samples from the individual regions were further mixed to obtain a set of 108 composite samples that would represent the whole country. A different, rationally based selection or combination of food samples has been used for some special analytical assessments (toxic PCB congeners, dibenzofurans and dioxins, nitrites and others). Table 1 gives a list of chemical substances quantified in the food samples, including the time development of the respective analyses.

Pre-analytical Treatment of the Food Samples

All the respective commodities are handled in accordance with the habits of the customers in the Czech Republic. The foodstuffs are cooked according to standard recipes, which were defined and modified on the basis of results of epidemiological investigations conducted in 1992 (29), 1996 (33) and 1999 (31). The individual foodstuffs are cooked in the central laboratory (NIPH Brno). Cooking water is taken from the local water supply. The water quality is regularly controlled by an independent organisation whether it complies with the natio-

GC-2xECD - gas chromatography with double electron capture detection; GC-MS - gas chromatography with mass detection; HPLC - high performance liquid chromatography; HPTLC - high performance thin layer chromatography; AAS-GF - atomic absorption spectrometry - graphite furnace; AAS-HT - atomic absorption spectrometry - hydride technique; AAS-FT - atomic absorption spectrometry - flame technique; AAS-AMA -analyser of mercury; SPEFO - spectrophotometry.

* since year 2000 aflatoxins and ochratoxin A are analysed in some specific samples when mycological analysis is positive for toxinogenic moulds.

nal standards. The food is cooked in the usual way using standards kitchen pots and pans. The cooked food is then used to prepare the composite samples, which are homogenised and handed over, for analyses. The changes in weight are recorded during cooking. The weight ratio "as consumed / as purchased" is used to correct the exposure dose calculations because data on food consumption in the form of "as purchased" were taken into account only.

Selection of Chemical Substances for Analyses

The basic principle is to analyse all the selected substances in the same composite sample. The selection of chemical substances for monitoring was based on considering, in particular, the following criteria: toxicity (34), data on the potential exposure dose (35-37), the objective and results of the food control system (38), public concern, international recommendations [WHO-GEMS FOOD (39)], but also the technological facilities of the analytical laboratories. The chemical substances are analysed in the central laboratory (NIPH Brno). Table 1 shows the extent of the investigated analytes, including the used analytical method.

Quality System

The quality system has been systematically developed since 1991/1992. All operations in the programme for monitoring the dietary exposure, from sampling to analytical methods and the filing of the results, are described in the standard operation procedures (SOP) and they are documented. The system also incorporates regular in-house quality controls. The focus is especially on the staff, including the training of new personnel. Consistent use is made of the available matrix reference material. A system of statistical regulation has been established. The laboratories take part in inter-laboratory comparative tests, both domestic and international (e.g. FAPAS UK). The entire system and the conducted tests have been accredited by the national accreditation body (Czech Accreditation Institute) according to CSN EN 45 001 (40). (We expect accreditation according to CSN EN ISO/IEC 17025 from 10/2002.) Once a year the national accreditation body checks how the quality system and accredited tests are functioning.

Analytical Methods

The applied analytical methods are described in the SOP as "in-house" methods based on corporate applications. For majority of elements atomic absorption spectroscopy (AAS) is used. Samples for the AAS were elaborated using microwave mineralisation. According to the nature of the sample and level of concentration in the food the following were used: graphite furnace (AAS-GF), flame technique (AAS-FT) and hydride technique (AAS-HT). Mercury is determined using a single-purpose mercury analyser (AMA 254), a photometer is used to quantify phosphorus and iodine. The relevant anions subject to investigations are NO_3^- and NO_2^- and are analysed by means of LC. Gas chromatography (GC) with double ECD detection was used to analyse the organic substances (PCB, OCP). GC-MS was used to analyse substances with a TCDD effect. Prior to analyses the samples were extracted and purified by means of GPC. The LC method was used to determine PAHs and carbamate pesticides in the pilot studies. A limited time was devoted to aflatoxins, which were determined using instrumentalised TLC and the samples were prepared using the immuno-affinite column.

Assessment of Exposure Doses and Risk Characterisation

Analytical data are elaborated by a group of specialists in toxicology and nutrition. The results are interpreted in standard form, i.e. the number of analysed samples, the number of analyses below the quantification limit, minimal and maximal values, means and standard deviation. If the analyte concentration in the composite sample is found to be below the limit of quantification of the analytical method, a value equalling 1/2 of the respective limit of quantification is used for further calculations what is one of the theoretical options (41). The obtained data are converted to exposure doses by multiplication of the analytical data using the conversion factor for culinary treatment and value of the consumed amount of the foodstuff. Exposure data achieved in the course of one calendar year represent an estimation of the exposure for an average individual in the Czech population. The mean value of the found analyte concentration is used to estimate the exposure on a national level. The value of the immediately detected concentrations of the analyte can be used to estimate the exposure in the individual studied places or regions.

The health risk characterisation is performed separately for the non-carcinogenic and carcinogenic effect. In outline also the intake of mineral substances and micronutrients is estimated. For characterisation of the health risk of non-carcinogenic effects (hazard index) the limits of the exposure value proposed by the JECFA FAO / WHO (42), SCF EU and US EPA (34) are used. The US EPA (34) methods are used to assess the carcinogenic effects (theoretical probability of an increasing number of tumour diseases). In our case the calculations of the risk assessment are based on information about the so-called carcinogenic potency of the chemical substance (Oral Slope Factor - OSF) and lifespan average daily doses (LADD) (43).

Data on the carcinogenic potency of chemical substances declared in the internationally recognised IRIS database (34) are used for the characterisation. In the majority of cases the WHO data (44) are used to evaluate the dietary requirements. If the recommended exposure limits have not been defined, we take the simple amount of exposure, or the exposure limits from other sources (HEAST US EPA) (45), from literature (46, 47), from decrees effective in the Czech Republic (48), from expert recommendations in the Czech Republic etc.

Publication of Results

The results of dietary exposure monitoring are published in detailed annual reports (49-54), also in cumulative reports of so-called the integrated monitoring "System of monitoring of the health condition of the population in relation to the environment" (55-60). The results have been presented at dozens of professional domestic and international conferences (61-71). The public can also draw information from Internet web sites (http://www.chpr.szu.cz/monitor/monitor.html).

CONCLUSION

The programme of dietary exposure monitoring realised in 1994-2001 has provided a large number of valuable information consistent with the laid down targets. The information was used in the area of drafting programmes for health protection and promotion, in regulatory work, and when settling problems of the international food trade (e.g. food contamination with arsenic within the WTO). Dozens of specialists from a number of institutions participated in the implementation and realisation of the programme, from hygienists to scientists. The Czech Republic is one of the EU candidate countries. The regular results of the programme are presented at the entry negotiations.

They also serve as groundwork for meetings of experts within the framework of OECD and WHO. The future of the long-term programme of dietary exposure monitoring is seen especially in the improvement of production of data on food consumption (transition to the evaluation of individual food consumption), in the updating of analytical techniques (introduction of ultra sensitive analytical methods) and elaborate more effective communication strategy focused on both experts and the general public.

Acknowledgement

The author wishes to thank specially to Dr. Jiří Ruprich, who is the national guarantee and the main manager of the dietary exposure programme in the Czech Republic since 1991/1992. His support and advice were instrumental in preparation of this paper.

The author also thanks all their fellow workers from the National Institute for Public Health and from the co-operating hygienic stations for their long-standing contribution to the implementation and realisation of the monitoring programme.

REFERENCES

1. **Stanners, D., Bordeau, P.:** Europe's Environment - The Dobříš Assessment, Copenhagen, European Environmental Agency 1995.
2. **Hertzman, C.:** Environment and Health in Central and Eastern Europe, Documents for the Environmental Action Programme for Central and Eastern Europe, Lucerne, World Bank 1993.
3. **Číhalík, J., Hajšlová, J., Penk, J., Sedláček, O., Svítil, J., Šindelářová, J., Turek, B., Zima, S.:** Food safety, Praha, The Ministry of the Environment 1991 (in Czech).
4. Food and Agriculture Organization of the United Nations / World Health Organization, Guidelines for Developing an Effective National Food Control System, Roma, FAO and UNEP 1976.
5. GEMS: Global Environmental Monitoring System, Joint FAO/WHO Food and Animal Feed Contamination Monitoring Programme: Summary and Assessment of Data Received from the FAO/WHO Collaborating Centres for Food Contamination Monitoring, Upsalla, National Food Administration 1982.
6. Joint UNEP/FOA/WHO Food Contamination Monitoring and Assessment Programme (GEMS/FOOD): Assessment of Dietary Intake of Chemical Contaminants, Nairobi, UNEP/FAO/WHO 1992.
7. The Resolution of the Czech Government No. 369/1991 to the Proposal of the System of Monitoring the Environmental Impact on Population Health of the Czech Republic (in Czech).
8. GEMS: Global Environmental Monitoring System, Guidelines for the Study of Dietary Intakes of Chemical Contaminants, Geneva, WHO Offset Publication, No. 87, 1985.
9. **Pennington, J.A.T., Gunderson, E.L.:** History of the Food and Drug Administration's Total Diet Study - 1961-1987, J.Assoc.Off.Anal.Chem. 70, 1987, 772-782.
10. Food and Drug Administration Pesticide Program: Residues in Foods 1990, Washington, DC, Food and Drug Administration 1991.
11. **Pennington, J.A.T.:** Total Diet Studies: the identification of core foods in the United States Food Supply. Food Additives and Contaminants 9 (3), 1992, 253-264.
12. **Gunderson, E.L.:** FDA Total Diet Study, April 1982-April 1984. Dietary intakes of pesticides, selected elements, and other chemicals. J. Assoc. Off. Anal. Chem. 71 (6), 1988, 1200-1209.
13. **Pennington, J.A.T.:** The 1990 Revision of the FDA Total Diet Study. J. Nutr. Educ. 24 (4), 1992, 173-178.
14. **Dabeka, R.W., McKenzie, A.D.:** Chemical contaminants monitoring, Total Diet Study of lead and cadmium in food composites: Preliminary investigation. J. AOAC Internat. 75 (3), 1992, 386-394.
15. **Stanhouse, F.:** The 1990 Austalien Market Basket Survey Report, Canberra. Australian government Publishing Service 1991.
16. The National Food Agency of Denmark: Food Monitoring in Denmark, Nutrients and Contaminants 1983-1987. Soborg, The National Food Agency of Denmark 1990.
17. **Urieta, I., Jalon, M., Garcia, J., Gonzalez de Galdeano, L.:** Food surveillance in the Basque Country (Spain) I. The design of a Total Diet Study. Food Additives and Contaminants 3, 1991, 371-380.
18. **Arnold, D., Somogy, A.:** Monitoring of residues and contaminants in food as a tool for the effective consumer protection. Arch. Lebensmittelhyg. 44, 1993, 41-46 (in German).
19. **Peattie, M.E., Buss, D.H., Lindsay, D.G., Smart, G.A.:** Reorganization of the British Total Diet Study for monitoring food constituents from 1981. Food Chem. Toxicol. 21 (4), 1983, 503-507.
20. Ministry of Agriculture, Fisheries and Food: The British Diet: Finding the Facts, Food Surveillance Paper, No. 23, London, Ministry of Agriculture, Fisheries and Food 1988.
21. WHO Environmental Health Criteria 6: Principles and Methodology for Evaluating the Toxicity of Chemicals, Part I, Geneva, WHO 1978.
22. WHO Environmental Health Criteria 70: Principles for the Safety Assessment of Food Additives and Contaminants in Food, Geneva, WHO 1987.
23. **Cohrssen, J.J., Covello, V.T.:** Risk Analysis: A Guide to Principles and Methods for Analyzing Health and Environmental Risks. Springfield, The National Technical Information Service 1989.
24. National Research Council: Issues in Risk Assessment, Washington, DC, National Academy Press 1993.
25. The Ministry of the Environment: The Environment of the Czech Republic, Praha, Academia 1990 (in Czech).
26. **Ruprich, J., Řehůřková, I., Dofková, M.:** Household budget survey in the Czech Republic and comparison with DAFNE results. Scand. J. Nutr. 43 (Supplement 34), 1999, 32.
27. **Nelson, M.:** Household data and national food survey. In: B.M. Margetts & M. Nelson eds. Design Concepts in Nutritional Epidemiology, New York, Oxford University Press 1995, 120-130.
28. **Trichopoulou, A., Kanellou, A., Lagiou, P., Zintzaras, E.:** Integration of nutritional data on household budget Surveys in European countries. Proc. Nutr. Soc. 55, 1996, 699-704.
29. **Ruprich, J., Černoevičová, M., Kopřiva, V., Ostrý, V., Resová, D., Řehůřková, I., Walterová, D.:** Food Basket for the Czech Republic. Brno, National Institute of Public Health 1993 (in Czech).
30. **Ruprich, J., Dofková, M., Kleinwächterová, H., Kopřiva, V., Resová, D., Řehůřková, I.:** Food Basket for the Czech Republic, Exposure Factors - CZ 1994. Praha, National Institute of Public Health 1997 (in Czech).
31. **Ruprich, J., Dofková, M., Kopřiva, V., Resová, D., Řehůřková, I.:** Food Basket for the Czech Republic, Exposure Factors - CZ 1997. Praha, National Institute of Public Health 2000 (in Czech).
32. **Brázdová Z., Ruprich J., Hrubá, D., Petráková, A.:** Dietary guidelines in the Czech Republic III.: Challenge for the 3rd millennium. Centr. Eur. J. publ. Health 9 (1), 2001, 30-34.
33. **Ruprich, J., Dofková, M., Kopřiva, V., Resová, D., Řehůřková, I.:** Food Basket for the Czech Republic: Complementary Epidemiological Studies and Dates. Praha, National Institute of Public Health 1997 (in Czech).
34. SilverPlatter Chem-Bank: Databanks of Potentially Hazardous Chemicals. IRIS., CD-ROM 2001.
35. **Dejonckheere, W., Steurbaut, S., Drieghe, S., Verstraeten, R., Braeckman, H.:** Pesticide Residues in Food Commodities of Vegetable Origin and the Total Diet Study in Belgium 1991-1993. Gent, Department of Crop Protection Chemistry, University Gent 1994.
36. **Gunderson, E.L.:** Dietary intakes of pesticides, selected elements, and other chemicals: FDA Total Diet Study, June 1984-April 1986. J. AOAC Internat. 78 (4), 1995, 910-921.
37. **Gunderson, E.L.:** FDA Total Diet Study, July 1986-April 1991 dietary intakes of pesticides, selected elements and other chemicals. J. AOAC Internat.78 (6), 1995, 1353-1363.
38. **Bednárková, M., Hajšlová, J., Hejmánková, L., Cuhra, P., Drápal, J., Pavelka, J., Strnad, Z., Šebesta, J., Valcl, O.:** Contamination of Food Chains with Foreign Substances, Situation in 1992, Pardubice, ÚVO 1993 (in Czech).
39. WHO: Monitoring and Assessment of Dietary Exposure to Potentially Hazardous Substances, Report on Meeting of the National Contact Points of the WHO European Programme (GEMS/Food-EURO) - Berlin 18-20 November 1992, Copenhagen, WHO 1993.
40. ČSN EN 45001 General Criteria for the Operation of Testing Laboratories, Praha, Vydavatelství norem 1991 (in Czech).
41. GEMS/Food-EURO: Second Workshop on Reliable Evaluation of Low-Level Contamination of Food. Report on a Workshop in the Frame of GEMS/Food-Euro, Kulmbach 1995.

42. FAO: Codex Alimentarius, FAO/WHO Standards, CD-ROM, Rome, FAO 1995.
43. U.S. Environmental Protection Agency: Guidelines for Exposure Assessment, Federal Register, 57 (104), 1992, 22888-22938.
44. World Health Organization: Trace Elements in Human Nutrition and Health, Geneva, WHO 1996.
45. U.S. Environmental Protection Agency: Health Effects Assessment Summary Tables FY-1995 Annual. Washington, DC, U.S. Government Printing Office 1995.
46. **Bowers, J., Brown, B., Springer, J., Tollefson, L., Lorentzen, R., Henry, S.:** Risk assessment for aflatoxin: An evalution based on the multistage model. Risk Analysis 13 (6), 1993, 637-642.
47. **Lee, Y.W., Dahab, M.F., Member, ASCE, Bogardi, I.:** Nitrate-risk assessment using fuzzy-set approach. J. Environ. Engeneer. 121 (3), 1995, 245-256.
48. Decree No. 293/1997 Coll. "on Calculation and Description of Nutritional value of Food".
49. **Ruprich, J., Řehůřková, I., Steinhauserová, I., Ostrý, V. et al.:** The Health Risk Assessment of Dietary Exposure to Selected Chemical Substances: Reported Alimentary Diseases (1993) and Total Diet Study (1994). Brno, National Institute of Public Health, 1995.
50. **Ruprich, J., Řehůřková, I., Steinhauserová, I., Ostrý, V. et al.:** The Health Risk Assessment of Dietary Exposure to Selected Chemical Substances: Reported Alimentary Diseases (1994, 1995) and Total Diet Study (1995). Praha, National Institute of Public Health, 1996.
51. **Ruprich, J., Řehůřková, I., Karpíšková, R., Ostrý, V. et al.:** The Health Risk Assessment of Dietary Exposure to Selected Chemical Substances in Year 1996: Reported Alimentary Diseases and Total Diet Study. Praha, National Institute of Public Health, 1997 (in Czech).
52. **Ruprich, J., Řehůřková, I., Karpíšková, R., Ostrý, V. et al.:** System of Monitoring of the Environmental Impact on the Population Health in the Czech Republic - Health Consequences of the Human Exposure to Foreign Substances from Food Chains: Reported Alimentary Diseases and Total Diet Study, Report for Year 1997. Praha, National Institute of Public Health, 1998.
53. **Ruprich, J., Řehůřková, I., Karpíšková, R., Ostrý, V. et al.:** The Health Risk Assessment of Dietary Exposure to Selected Chemical Substances in 1998: Reported Alimentary Diseases and Total Diet Study. Praha, National Institute of Public Health, 1999 (in Czech).
54. **Ruprich, J., Řehůřková, I., Karpíšková, R., Ostrý, V. et al.:** The Health Risk Assessment of Dietary Exposure to Selected Chemical Substances in 1999: Reported Alimentary Diseases Bacteriological and Mycological Analysis of Food and Total Diet Study. Praha, National Institute of Public Health, 2000 (in Czech).
55. **Kazmarová, H., Drahoňovská, H., Havlík, B., Šišma, P., Ruprich, J., Černá, M., Turek, B., Kodl, M.:** System of Monitoring the Environmental Impact on Population Health of the Czech Republic, Summary Report - 1994. Praha, National Institute of Public Health, 1995 (in Czech).
56. **Černá, M., Drahoňovská, H., Faierajzlová, V., Havlík, B., Kazmarová, H., Kodl, M., Ruprich, J., Šišma, P., Tichý, M.:** System of Monitoring the Environmental Impact on Population Health of the Czech Republic, Summary Report - 1995. Praha, National Institute of Public Health, 1996.
57. **Dofková, M., Karpíšková, R., Ruprich, J., Řehůřková, I., Šrámová, H.:** Results of subsystem 4: Health consequences and risks of human dietary exposure to chemicals. In: Černá, M., Kazmarová, H., Kodl, M., Kratzer, K., Ruprich, J., Šišma, P., Tichý, M.: System of Monitoring the Environmental Impact on Population Health of the Czech Republic, Summary Report - 1996. Praha, National Institute of Public Health, 1997.
58. **Beneš, Č., Dofková, M., Karpíšková, R., Ruprich, J., Řehůřková, I., Šrámová, H.:** Results of subsystem 4: Health consequences and risks of human dietary exposure to chemicals. In: Černá, M., Kazmarová, H., Kratzer, K., Ruprich, J., Šišma, P., Tichý, M.: System of Monitoring the Environmental Impact on Population Health of the Czech Republic, Summary Report - 1997. Praha, National Institute of Public Health, 1998.
59. **Beneš, Č., Dofková, M., Karpíšková, R., Ruprich, J., Řehůřková, I., Šrámová, H.:** Results of subsystem 4: Health consequences and risks of human dietary exposure to chemicals. In: Černá, M., Gregůrková, M., Kazmarová, H., Kratzer, K., Ruprich, J., Šišma, P., Tichý, M.: System of Monitoring the Environmental Impact on Population Health of the Czech Republic, Summary Report - 1998. Praha, National Institute of Public Health, 1999 (in Czech).
60. **Beneš, Č., Dofková, M., Karpíšková, R., Ostrý, V., Ruprich, J., Řehůřková, I., Šrámová, H.:** Results of subsystem 4: Health consequences and risks of human dietary exposure to chemicals. In: Černá, M., Kazmarová, H., Kratzer, K., Ruprich, J., Sikačová, Z., Šišma, P., Tichý, M.: System of Monitoring the Environmental Impact on Population Health of the Czech Republic, Summary Report - 1999. Praha, National Institute of Public Health, 2000 (in Czech).
61. **Ruprich, J.:** Total Diet Studies in the Czech Republic, In: GEMS/Food Total Diet Studies, Report of a Joint USFDA/WHO International Workshop on Total Diet Studies - Kansas City, Geneva, WHO 1999.
62. **Ruprich, J.:** Environment and Health Monitoring in the Czech Republic: Dietary Exposure to Chemical Substances, Workshop lecture: Health Impact of Environmental Degradation in the Czech Republic. Atlanta, USA, 1994.
63. **Ruprich, J., Řehůřková, I. et al.:** Exposure of the Population CZ to Foreign Substances in the year 1994: an Estimate. Proceedings of the Conference "Foreign Substances in Food" Tatranská Štrba, 1995, 65-68 (in Czech).
64. **Ruprich, J.:** Food Composition Activities in the Czech Republic, International Course "FoodComp'96", Wageningen, 1996, 9 pages.
65. **Ruprich, J.:** Food Basket for the Czech Republic - Improvement of the Data for the Health Risk Assessment. Proceedings of the Conference "Foreign Substances in Food", Tatranská Štrba, 1997, 4 pages (in Czech).
66. **Ruprich, J.:** Using Food Composition Tables in the Czech Republic, Lecture of the Workshop "User Priorities and Data Quality". 7th Management Committee Meeting, European Programme COST 99, Warsaw, Poland, 1997, 5 pages.
67. **Ruprich, J., Řehůřková, I.:** Food Composition and Consumption in the Czech Republic: Is Dietary Intake of Selenium Growing Up? Lecture of the Workshop COST 99 Workshop: CEECFOODS Activities, Turku, Finland, 1998, 7 pages.
68. **Ruprich, J., Dofková, M., Řehůřková, I.:** Intake of Vitamins and Minerals from Dietary Supplements by the Czech Population, Lecture of Workshop COST 99 Workshop: Recent CEECFOODS Activities, Wageningen, the Netherlands, 1998.
69. **Borkovcová, I., Mullerová, I., Řehůřková, I., Ruprich, J.:** Iodine Content Data for the Czech Food Nutrition Table. Proceedings of the International Conference "Third International Food Data Conference Back Basics", Roma, 1999, 53.
70. **Ruprich, J., Řehůřková, I., Borkovcová, I., Mullerová, I. et al.:** Study of Using and Content of Iodine in Salt in the Czech Republic. Proceedings of the International Conference "Third International Food Data Conference Back to Basics", Roma, 1999, 61.
71. **Ruprich, J. et al.:** Total Diet Study in the Czech Republic. Proceedings of International Conference "The International Workshop on Total Diet Study", WHO/FDA USA, Kansas City, 1999, WHO/SDE/PHE/FOS/99.9, 5.

Received October 25, 2001