CROATIAN MEDICAL JOURNAL

41(2):150-153,2000

FORUM:
HEALTHY ENVIRONMENT

Small Countries and the Dioxin Scandal: How to Control Imported Food?

Dinko Puntarić, Zdenko Šmit, Jasna Bošnir, Jasna Topolovec

Zagreb Institute of Public Health, Zagreb, Croatia

The aspiration of the countries in transition to join the developed European countries resulted in opening their borders and several-fold increase in import, especially of food products. The imported foods are less expensive than domestic ones, but their quality is often highly questionable. In analyzing the safety of these products for human health, small countries encounter at least two sets of problems. One is related to legal provisions on the parameters to be analyzed, whenever new requirements emerge in practice, like the latest one on dioxin. The other, even more difficult set of problems, is related to the expensive equipment needed for the monitoring of foodstuff safety, the procurement of which exceeds the financial possibilities of these countries. For example, from June 11 until July 31, 1999, during the so-called European dioxin crisis, a total of 58 foodstuffs produced in Belgium, Netherlands, and France between January 19 and March 3, 1999, were referred to the Department of Health Ecology, Zagreb Institute of Public Health, the only laboratory authorized for identification of polychlorinated dibenzodioxins and dibenzofurans in the Republic of Croatia. In 40 samples, the level of dioxin was below the detection limit of 0.5 ng – international toxic equivalents per kg fat (ng-I-TEQ/kg fat), whereas in 18 positive samples the level of dioxin did not exceed the limit of 5 ng-I-TEQ/kg fat for the foodstuff commercial usability. Although highly contaminated products have not yet appeared on the Croatian market, recent developments in Europe have clearly pointed to the need of establishing an authorized laboratory for dioxins in the Republic of Croatia or in the region.

Key words: *carcinogens; Croatia; dioxins; food adulteration; food analysis; laboratory techniques and procedures; mutagens; teratogens*

Natural striving of the countries in transition, their need, and political priority is to reach a higher level of development and become equal members of the European Union. In general, this implies introducing "open border" system and utmost liberalization of the goods and service turnover, including the production, processing, transport, and sale of foodstuffs, which means a large-scale import of foodstuffs from developed countries. That is the usual scenario.

This import includes products of large international corporations, such as *Coca Cola* or *McDonald's*, whose entrance to the market of a country in transition is welcomed and, in the absence of some better indicators, even considered "a civilizational and political progress" on the country's sway toward welfare of the West. In addition to the fact that tapping new markets with such products is highly profitable for the manufacturers, putting new production, plants, and wholesale companies into operation opens vacancies and reduces unemployment, and is therefore considered an economically favorable step. These corporations use high technology, with double control performed through internal laboratories and authorized institutions (1). Therefore, there are generally no major problems concerning the product quality and health safety.

On the other hand, uncontrolled import of all other foodstuffs presents a major problem indeed, quite independent of the development level of the food industry in a particular country. Imported foods are less expensive than domestic products, and their import is highly profitable for the "privileged" companies operating hand-in-hand with "governmental" importers. The food imported from developed countries is cheaper due to massive-scale breeding, processing, production, transportation, and sale and is related to the use of up-to-date technology. However, high quality means high price. In other words, from a vast diversity of products of varying prices, made by various manufacturers, the products exported to developing countries are often the cheapest on the market, of dubious origin and quality, and fre-

quently even of questionable health safety (2). Actually, these products usually contain foods that cannot be sold anymore on the market of the country of their origin.

Croatia has recently faced an absurd situation that resulted from both market liberalization and inappropriate governmental policy. Instead of imposing itself as a significant food exporter, as it could based on its natural resources, Croatia has become a great food importer. As early as 1994, the Minister of Health and a group of nutritionists submitted to the government a proposal on food import control through a central governmental agency, in order to protect the Croatian market from low-quality import products. The proposal was declined. Moreover, many laboratories outside health care system, which frequently lacked even the basic equipment, were licensed to perform the control of imported foodstuff.

The next problem encountered in the control of foodstuffs in Croatia is related to modifications in the manufacturing conditions and circumstances, which have not been adequately accompanied by legal provisions, and especially not by financial resources. For example, the Law on Health Safety of Foodstuffs and respective by-laws contain provisions on the control of foods sensory characteristics (color, taste, odor, consistency), microbiological safety, and presence of organochlorine pesticides, heavy metals and polychlorinated biphenyls (1). However, the legislation does not even mention the need for monitoring radioactive isotopes, organophosphorus pesticides, ochratoxin A, N-nitrosamines, phthalates, let alone genetically modified food and recent cases of poisoning with so far unknown *Escherichia coli* O157:H7 and *Listeriae* sp. (3,4).

The Dioxin Scandal

One of the most recent problems with food safety that attracted special attention because of importance was the problem of polychlorinated dibenzodioxins (PCDD) and dibenzofurans (PCDF) in food, popularly known as dioxins (5). Dioxins are in a greater or lesser amount ubiquitously found in the environment. Their formation is exclusively associated with human activities (6). It is indeed absurd to have dioxins as "the most toxic compounds ever produced by man" (the allowed daily intake is only 1-4 pg/kg body weight), because they have never had any purpose nor commercial usage (7,8). Their immunogenicity (9), teratogenicity (10), mutagenicity (11), and carcinogenicity (12) have been demonstrated at doses as low as 10^{-12} g *per* kg fat.

Dioxins are formed as intermediaries or by-products during various chemical technology processes. Generally, any two molecules of chlorinated phenols, if containing chlorine in the ortho-position relative to the hydroxyl group, can fuse into a dioxin molecule at a temperature that is still not high enough for complete combustion. Thus, the major sources of dioxins are firerooms, municipal and hazardous waste incinerating plants, pesticide manufacturing plants, and exhaust gases (5-7). The importance of dioxins for humans derives from their marked lipophilic quality. After being inhaled, resorbed through the skin or, most commonly, ingested with food, dioxins accumulate in the fatty tissue and liver, wherefrom they can be released in the conditions of fatty tissue loss (13).

There is no act or law in Croatia or in the world, which regulates routine monitoring of dioxins in foodstuffs. May such a law be enacted, it should apply to all products that contain more than 10% of animal fat (13,14,15).

In June and July 1999, Europe was shaken by the "dioxin scandal", based on the finding of dioxin-contaminated oil concentrate intended for poultry and cattle feed, and distributed to breeding farms all over Belgium, Netherlands, and some parts of France. Feeding animals with contaminated food from January 19 until March 3, 1999, resulted in the production of unsafe and potentially life-threatening food products. The fact that food manufacturers of high reputation, exporting their products to all European countries, were involved, added to the severity of the problem (14).

Although the Belgian Ministries of Agriculture and Health tried to hush up the accident, the facts were eventually unveiled to the public on May 29-30, 1999 (16). This instantaneously resulted in putting a ban on the import of incriminated products from Belgium, Netherlands, and parts of France to other European Union countries, and after short time to every other country, including Croatia (14,17).

Identification of Dioxins in Food

The methodology of dioxin identification was developed when an increased incidence of malignant diseases was recorded among American soldiers who used directly exposed to been in the use of Agent Orange herbicide (a combination of 2,4-dichloroacetic acid and 2,4,5-trichloroacetic acid in diesel) had as an exfoliant during the war in Vietnam. The herbicide was found to be contaminated with dioxins due to inappropriate control of the herbicide synthesis (7,18,19).

In the routine work, the reliability of the methodology was verified after the accident in Meda (Seveso, Italy), where a plant for the production of 2,4,5-trichlorophenol from tetrachlorobenzene and sodium hydroxide had blown up. The explosion resulted from an uncontrolled reaction over the week-end, in which a great amount of 2,3,7,8-tetrachlorodibenzodioxin (TCDD) developed because of the high temperature, and dispersed all over the surrounding area. Sera of nearly 30,000 exposed individuals were tested (7,18-20). Although initial results did not point to the correlation between the exposure to dioxin and occurrence of carcinoma, subsequent studies re-

vealed an increase in the incidence of cancer, especially breast cancer (20). Animal studies of toxicity and finding that the exposure to low doses of environmental dioxins can be detrimental to living organisms due to the phenomenon of bioaccumulation, led to the correction of the so-called tolerable daily intake from 10 to 1-4 pg/kg body mass. This is the limit recommended for environmental dioxins, particularly dioxins that come from pesticide manufacture and waste incineration (especially hazardous waste) (21).

The procedure of specimen preparation is quite complicated, expensive, and time-consuming. Determination of dioxin in amounts as small as 10^{-9} to 10^{-12} g *per* kg fat requires a specific and very expensive high-resolution technique (the price of the instrument is about DM1 million), which is the main reason why the matter now rests on recommendations only and why hardly any country has introduced systematic monitoring of environmental dioxin levels, apart from running some sporadic tests (8,21).

Dioxins in Food Imported to Croatia

Based on the decision of the Minister of Agriculture of the Republic of Croatia from June 10, 1999, a ban has been put on the import of foodstuffs with animal fat content exceeding 10% of total mass of the product, manufactured in Belgium, Netherlands, and parts of France (17). In collaboration with the National Sanitation Department and National Inspectorate, 58 foodstuffs were referred to the Department of Health Ecology, Zagreb Institute of Public Health. Specimens of the following foodstuff groups were included: meat products (n=10), dairy products (n=14), baby food (n=12), ice-cream (n=11), chocolate (n=5), and other foodstuffs (n=6).

The usual methods of extraction and extract treatment were used in the analysis, including a combination of gas chromatography and mass spectrometry (a GC-MS system, Q-MASS 910 Benchtop Mass Spectrometer, Perkin-Elmer, Überlingen, Germany) with obligatory criteria of high sensitivity and identification uniformity, modified according to the US-EPA Method 8280 (21). All specimens were analyzed for the presence of *tetra-*, *penta-*, *hexa-*, *hepta-*, and octachlorodibenzo-*p*-dioxins and dibenzofurans (PCDD and PCDF). Eighteen (31.0%) of 58 specimens analyzed for the presence of dioxin were positive (Table 1). The amount of dioxin did not exceed the limit of the product commercial usability of 5 nanograms-international toxic equivalents *per* kg fat (ng-I-TEQ/kg fat) in any of the analyzed samples. According to the foodstuff groups, the highest proportion of positive specimens was recorded for meat (6/10) and dairy (7/14) products, whereas no dioxin could be identified in baby food specimens.

Table 1. Presence of polychlorinated dibenzodioxins (PCCD) and dibenzofurans (PCDF) in imported foodstuff specimens analyzed at the Zagreb Institute of Public Health in June and July 1999

Type of food	No. of samples	No. of positive samples	Dioxin amount (ng-I-TEQ/kg fat)[a]
Meat products	10	6	ND[b] –3.2
Dairy products	14	7	ND – 1.4
Baby food	12	0	ND
Ice-cream	11	3	ND – 1.2
Chocolate	5	1	ND – 0.7
Other	6	1	ND – 0.6
Total	58	18	ND – 3.2

[a]TEQ (Toxicity Equivalent) is the concentration of each dioxin multiplied by its TEF (Toxicity Equivalent Factor) – the toxicity of each dioxin expressed relative to the toxicity of 2,3,7,8-TCDD, which has a value of 1.
[b]ND (non detectable) is an amount less than 0.5 ng-I-TEQ/kg fat, calculated according to 2,3,7,8-TCDD toxicity.

Recommendations for the Future

Besides the fact that a large-scale import of inexpensive food may occasionally lead to the exposure to the food potentially contaminated with dioxins, there are at least two more reasons why an institution authorized for systematic monitoring of environmental dioxin should be founded in Croatia. One reason is the existence of chemical industry (especially pesticide manufacture), where a variety of imported chemicals, particularly those from the former Soviet Union countries, known to contain certain amounts of dioxins due to the inappropriate manufacturing process, are being used without control. The other reason includes the consequences of the war in Croatia and destruction of a number of power-supply facilities, where chemicals (polychlorinated biphenyls) that can develop dioxins during incomplete combustion, have been used as cooling fluids. At present, there is practically no knowledge on the issue (22-24).

Other countries in transition do not have a better choice. In addition to the food import, most of them have agreed to accept the plants of the so-called "dirty industry" as the form of "industrial help of the West". In spite of the high costs implicated, they simply have to develop their own system of environmental dioxin monitoring. Each country in transition, including Croatia, cannot afford "high resolution" mass spectrometer. We believe that a Regional Institute for the central and east European countries, with adequate equipment and staff, could serve the need for the control of dioxin and other contaminants in the food. Individual countries can use ordinary mass spectrometers to screen the samples for dioxin and send potentially contaminated samples to such a regional institute.

Parallel investments in their own food industry, along with other comparative advantages (e.g., tourism in a healthy environment), would gradually reduce the import requirements, and this should be the main developmental strategy of these countries, especially Croatia.

References

1 Zakon o zdravstvenoj ispravnosti i zdravstvenom nadzoru nad namirnicama i predmetima opće uporabe. Narodne novine 1997;1:39-46.

2 Bošnir J, KneŽević-Jonjić N. Izvještaj o radu Odjela za higijenu prehrane u 1998. godini. In: Baklaić Ž, Puntarić D, editors. Izvješće o stanju i radu javnog zdravstva u gradu Zagrebu tijekom 1998. godine. Zagreb: Zavod za javno zdravstvo grada Zagreba; 1999. p. 82-92.

3 Nester EW, Roberts CE, Nester MT. Classification and identification of bacteria. In: Sievers EM, editor. Microbiology. Dubuque (IA): WmC Brown Publishers; 1995. p. 218-36.

4 Nester EW, Roberts CE, Nester MT. Epidemiology and public health. In: Sievers EM, editor. Microbiology. Dubuque (IA): WmC Brown Publishers; 1995. p. 402-19.

5 Baird C. Environmental chemistry. New York (NY): WH Freeman & Co; 1994.

6 Sagunsky H, Perger G. Biozide. In: Marquardt H, Schäfer SG, editors. Lehrbuch der Toxikologie. Stuttgart-Köln: KNO-K&V; 1994. p. 439-91.

7 Patterson DG, Needham LL, Andrews JS. Polychlorinated dibenzo-*p*-dioxins. In: Lester Haddad M, Winchester JF, editors. Clinical management of poisoning and drug overdose. Philadelphia (PA): Saunders; 1990. p. 528-37.

8 World Health Organization Press Releases. WHO experts re-evaluate health risks from dioxins. Geneva: WHO; 1998.

9 Esser C. Dioxins and the immune system: mechanisms of interference: a meeting report. (Second Düsseldorf Symposium on Immunotoxicology; Düsseldorf, Germany, June 1993). Int Arch Allergy Immunol 1994;104:126-30.

10 Jahn O, Ruediger HW. How real are teratogenic damages due to dioxin? Atemwegs und Lungkrankheit 1995;21(Suppl 1):62-4.

11 Huff JE, Salmon AG, Hooper NK, Zeise L. Long-term carcinogenesis studies on 2,3,7,8-tetrachlorodibenzo-*p*-dioxin and hexachlorodibenzo-*p*-dioxins. Cell Biol Toxicol 1991;7:67-94.

12 Fingehut MA, Halperin WE, Marlow DA, Piacitelli LA, Honchar PA, Sweeney MH et al. Cancer mortality in workers exposed to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin. N Engl J Med 1991;324:212-8.

13 Hackenberger BK, Puntarić D, Šmit Z, Bošnir J. Značenje i potreba određivanja i sustavnog praćenja polikloriranih dibenzodioksina i dibenzofurana u namirnicama i okolišu. In: Cukor S, Dijana K, Maver H, Sučić T, editors: Prehrambeno stanje i zdravlje. Zbornik radova. Zagreb: Medicina i tehnika; 1997. p. 571-82.

14 Baars AJ. The dioxin in chicken calamity – trouble or trifle? In: Prpić-Majić D, Kniewald J, editors. CROTOX 2000. Final Programme and Abstract Book of the 2th Croatian Congress of Toxicology; 2000 April 9-12; Pula, Croatia. Zagreb: Croatian Toxicological Society, Institute for Medical Research and Occupational Health; 2000:24.

15 Commision of the European Communities. White paper on food safety. Brussels, 12 January 2000. http://europa.eu.int/comm/dg24/library/pub/pub06_en.pdf; p. 41.

16 Belgium government. Contamination of animal feedstuffs with dioxin – chronological order. www: //belgium.fgov.be/pb/pbh/enbh02.htm.

17 Naredba o privremenoj zabrani uvoza u Republiku Hrvatsku Živih Životinja, proizvoda Životinjskog podrijetla i stočne hrane iz Belgije, Nizozemske i Francuske. Narodne novine 1999;59:2129-30.

18 Kang HK, Watanabe KK, Breen J, Remmers J, Conomos MG, Stanley J, et al. Dioxins and dibenzofurans in adipose tissue of USA Vietnam veterans and controls. Am J Public Health 1991;81: 344-9.

19 Schecter A, Le-Gao-Dai, Le-Thi-Bich-Thuy, Hoang-Trong-Quynh, Dinh-Quang-Minh, Hoang- Dinh--Cau, et al. Agent Orange and Vietnamese: the persistence of elevated dioxin levels in human tissues. Am J Public Health 1995;85:516-22.

20 Mocarelli P, Needham LL, Marocchi A, Patterson DG, Brambilla P, Gerthoux PM, et al. Serum concentrations of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin and test results from selected residents of Seveso, Italy. J Toxicol Environ Health 1991;32:357-66.

21 EPA Working Group. Test methods for evacuating solid waste. Method 820, Revision 0. USEPA-SW-846. Washington D.C.: Office of Solid Waste; 1986.

22 Richardson ML. The assesment of hazards and risks to the envirnoment caused by war damage to industrial installations in Croatia. Kemija u Industriji 1994;43(3):115-24.

23 Richardson ML, editor. The effects of war on the environment: Croatia. London: E&FN Spon; 1995.

24 Plavšić F, Petrovečki M, Fuchs R, Šoštarić B, Wolf-Čoporda A, Bairuši D, et al. Chemical and ecological aspects of the war against Croatia. Croat Med J 1992; 33 War Suppl 2:220-4.

Received: March 28, 2000
Accepted: April 15, 2000

Correspondence to:
Dinko Puntarić
Department of Health Ecology
Zagreb Institute of Public Health
Mirogojska c. 16
Zagreb, Croatia
dinko.puntaric@public-health.tel.hr