

## COUNTRY REPORT

## CONTAMINATION OF FOOD AND AGRO PRODUCTS IN THE REPUBLIC OF MACEDONIA

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The Republic of Macedonia has 662,000 ha of cultivated land with well-organised agricultural production. It is a well known producer of agricultural products. From 1991 to 1999, authorised laboratories conducted systematic control of about 6,500 food samples in 1991 to 36,000 by 1999 which included a whole range of hygienic quality parameters including microbiological and chemical. Microbiological contamination of food was reported to have caused disease outbreaks in 1,578 people in 1995, which dropped to 126 people in 1999. The decreasing trend of samples unfit for human consumption was observed for all food groups. As for the chemical parameters, an increasing trend of contaminated samples was noted only for additives, with peaks reaching 6.9% in 1998 and 4.9% in 1999 of the total number of analysed samples.

*Key words:*  
chemical parameters, food contamination,  
microbiological parameters

**I**t is estimated that every year around 130 million Europeans are affected by food-borne diseases (1). Diarrhoea – the major cause of death and retarded growth in infants – is the most common symptom of food-borne illnesses (2). While biological hazards are of great concern because contaminated foods can cause widespread outbreaks of diseases, chemical hazards may also cause food-borne illnesses, although generally affecting fewer people. Chemical hazards can originate from many sources such as agricultural chemicals (pesticides, fertilizers, and animal drugs), natural toxicants (plant, animal, or microbial products), preservatives, food additives, sulfating agents, environmental contaminants (lead, cadmium, mercury, arsenic, polychlorinated biphenyls (PCBs), and so on (3).

Sources of contamination of food, both chemical (pesticides, heavy metals, and other contaminants) and biological, can be found at any stage of the food chain.

Food can be contaminated during at various stages of agricultural production, storage, transport, processing, packaging, and final preparation (4).

The Republic of Macedonia has 662,000 ha of cultivated agricultural land and a well-organised agricultural production. Beside intense, yet deficit-producing industrial export, Macedonia is a well known producer of agricultural products (5).

The existing food legislation in the Republic of Macedonia is not updated and properly coordinated, that is, the food control system is based on the common approach, generally involving inspection and control of final products, after which follows the sanctioning of detected nonconformities (reactive as opposed to proactive approach).

## MATERIALS AND METHODS

Food samples taken between 1991 and 1999 included domestic and imported products and were analysed according to parameters described in Act on Food and Objects of Common Use (published in the *Official Journal of the Republic of Macedonia* 51/84) and a number of bylaws. Authorised laboratories in the Republic of Macedonia used standard methods such as flame atomic absorption spectrometry for heavy metals and gas chromatography for pesticides to examine the hygienic and sanitary quality of food samples and check microbiological and chemical parameters. The analysed data have been and published in the Yearbooks of the Republic Institute for Health Protection in Skopje, Macedonia (6)

## RESULTS AND DISCUSSION

Microbiological contamination of food has been recognised as a health hazard all over the world, including Macedonia. It can be of plant or animal origin and can occur in primary production (ill or infected animals, contaminated plant products consumed fresh), processing, storage, or distribution. Biological contamination, which is mainly bacterial, can cause food-borne infections or intoxications. (7) The Republic Institute for Health Protection maintains the national surveillance system for monitoring incidents of food poisoning with enteric pathogens. A food-borne intoxication is caused by ingestion of already formed toxins such as staphylococcal enterotoxin produced by some bacteria which multiply in food (2). Table 1 shows the annual distribution of

Table 1 Annual distribution of microbiological food-borne poisoning incidents and epidemic outbreaks reported for the period 1991-1999 in the Republic of Macedonia

Microbiological food-borne diseases	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total number of victims	1574	1319	1253	1365	1578	1456	237	305	126
Total number of outbreaks	4	3	3	8	4	4	9	7	5

incidents of food-borne microbiological poisoning and registered outbreaks in the Republic of Macedonia. The Table 2 shows the annual distribution percentage of samples found unsuitable for human consumption by food groups for the period 1991-1999. In that 10-year period, the number of food samples included in systematic control grew from about 6,500 samples in 1991 to about 36,000 in 1999.

Table 2 *Microbiological distribution of improper samples by food groups expressed in percentages*

Food groups	1991	1992	1993	1994	1995	1996	1997	1998	1999
Milk	8.58	10.5	4.5	6	5.7	6.2	7.8	9.05	4.17
Milk products	3.38	4.8	4.3	16.4	2.4	6.6	18.5	8.5	9.9
Meat	31.8	23.9	9.1	9.8	8.8	6.2	7.8	13.7	3.75
Meat products	8.25	5.6	6.3	13	2.4	3.5	7.6	5.98	3.01
Fruit products	3.3	2.5	2.9	1.4	4.8	5.6	2.3	1.6	0
Vegetable products	1.7	4	8.1	2.1	8.6	2.5	7.8	0.2	2.5
Nonalcoholic beverages	1.1	2.5	2.3	16.5	2.4	1.1	2.3	1.54	2.7

Chemical analysis for contaminants mainly concerned the imported products. Table 3 shows the distribution of samples by contaminants for the period 1991-1999 and the percentage of improper samples in the total number of the examined samples.

Table 3

Contaminants	1991	1992	1993	1994	1995	1996	1997	1998	1999
Pesticides-TN	1946	2990	4650	12334	10402	9871	10199	9218	9329
% of IS	0.51	0.2	0.84	0	0.02	0.01	0	0.01	0.05
Heavy metals-TN	2958	379	5484	12882	13713	14544	14503	13756	13499
% of IS	0.067	1.1	0.51	0.04	0.36	0.15	0.07	0	0.08
Additives-TN	575	1363	3145	3119	3594	7537	8507	2655	3944
% of IS	0	0.51	5.56	0.25	3.3	1.8	2.3	6.9	4.3
Mycotoxins-TN	344	1084	2084	1434	1823	1669	2245	1733	1477
% of IS	0	0	0	1.28	0.77	0	0	0.01	0
Antibiotics-TN	827	1241	1505	3955	4880	6923	4109	3065	597
% of IS	0.96	0.08	0.13	0.07	0	0	0	0	2.6
Hormones-TN	350	534	777	718	578	113	577	686	678
% of IS	0	0	0	0	0	0	0	0	0

Of pesticides, only organochlorine and organophosphoric insecticides are monitored in food. Carbamate insecticides and herbicides have been tested in a limited number of rice samples taken in the area of Koèani. Of 10,000 samples tested for the presence of insecticides a year, 0,01% were above the maximum permitted concen-

tration (MPC). Of organochlorine insecticides, the presence of lindane and hexachlorocyclohexanes isomers (HCH) were detected. The tested rice samples from the area of Koèani showed concentrations 10–100 times and 2–20 times below the MPC for lindane and HCH, respectively. The organic chemical plant OHIS Skopje located near the village of Lisice poses a particular threat of food contamination. Namely, 10% of samples from that area showed HCH concentrations twice as high as the MPC. Organophosphoric pesticides were detected in none of 10–12,000 samples tested each year. Of herbicides, propanil was found in an average concentration of 0.01 mg/kg and molinate in concentrations of 0.1 mg/kg, which is significantly below the MPC, whereas carbaril was not detected at all.

Detected concentrations of lindane in plant products were very low, ranging between 0.2 and 2.6% of MPC. In milk, those concentrations were 17%, in milk products 24%, in meat 7% and meat products 4.8% of the MPC. Compared to the WHO-FAO results, our findings keep within the average ranges for individual products in Europe. Contamination of milk with HCH is 5 times lower than MPC, of milk products 6 times, of meat and meat products 20 times, of fruit 10 times, and of vegetables 3 times (5).

Annually, 4,000 samples of additives undergo testing, of which only 1,530 are added to domestic products. Two percent of imported products were prohibited for sale, as they contained prohibited additives or excessive quantities of additives. In domestic production, additive-related problems usually occur with small enterprises which lack professional approach to food processing. The most frequent violations concern excessive quantities of additives in refreshing beverages, meat products, and artificial sweeteners in confectionery products and ice creams in particular.

## CONCLUSION

The large number of private farmers and small food processing enterprises and an even larger number of small trade and catering firms in the Republic of Macedonia make the legal control very difficult. Given the general, imprecise nature of legal stipulations, many of those entities work on improper premises, with inadequate equipment, or with unskilled staff, failing thus to secure standard hygienic conditions. Food is often sold on traditional marketplaces with poor hygienic conditions. The so called fast food restaurants seem to pose the greatest risk, and the most frequently reported violations by shops and catering services are associated with the use of groceries of unknown origin, inadequate thermal treatment, failure to observe prescribed storing temperatures, and low level of staff training.

However, when it comes to microbiological parameters, this trend has been decreasing trend in all food groups. As for the chemical parameters, an increase has been noted only for additives.

The Republic of Macedonia should establish a modern system of food control by adopting laws and other legal acts conforming with international recommendations, regulations, and standards. The national Food Agency established in 1999 and acting within the Ministry of Health should clearly define the responsibilities of relevant ministries and establish a common administration service for fast and effective control

over health safety and inspection of food with full interdisciplinary staffing, purchase of missing equipment for diagnostic laboratories, and additional training of the existing and employment of new staff on the basis of sectional competencies defined by the Priorities and Action Plan.

## REFERENCES

1. The impact of food and nutrition on public health. Minutes of the Regional Committee for Europe, Fiftieth session; 11-14 September 2000; Copenhagen, Denmark: WHO; 2000.
2. Baird-Parker A. Food-borne illness: food-borne salmonellosis. Lancet 1990;336:1231-5.
3. European Environment Agency (EEA). Environment in the European Union at the turn of the century. Environmental assessment report 1999; 2:111-131
4. Conacher H, Mes J. Assessment of human exposure to chemical contaminants in food. Food Addit Contam 1993;10:5-15.
5. Ministry of Health (Republic of Macedonia). National health environment action plan. Skopje: Ministry of Health; 1999.
6. Republic Institute for Health Protection (Republic of Macedonia). Program for preventive health protection. 1993-2000 yearbook. Skopje.
7. Farber J, Hughes A. General guidelines for the safe handling of foods. Diary Food Environ Sanitation 1995;15:70-8.

## Sažetak

### KONTAMINACIJA HRANE I AGROPROIZVODA U REPUBLICI MAKEDONIJI

Republika Makedonija ima 662.000 ha kultiviranih poljoprivrednih površina s dobro organiziranom poljoprivrednom proizvodnjom. Pored brojnog deficitarnog industrijskog izvoza, Makedonija je dobro poznati proizvođač ponajprije poljoprivrednih proizvoda. Tijekom proteklog 10 godišnjeg razdoblja (1991-1999) prehrambeni su proizvodi uključeni u sistematsku kontrolu u autoriziranim laboratorijima te je tako od 6500 proizvoda 1991. godine do 36000 uzoraka analizirano na zdravstvenu ispravnost, mikrobiološke i kemijske parametre.

Mikrobiološka kontaminacija hrane uzrokovala je nekoliko akcidenata a objavljeni broj žrtava kretao se od 1578 u 1995. god. do 126 osoba u 1995. god. Uočljiv je trend smanjenja uzoraka hrane koji nisu za ljudsku prehranu u svim vrstama hrane.

Od kemijskih parametara jedino je za aditive uočen trend porasta broja uzoraka koji ne zadovoljavaju kriterije za ljudsku prehranu. Najveći broj uzoraka koji nisu bili prihvatljivi, u odnosu na sve analizirane uzorke, zabilježen je 1998. god. (6,9%) i 1999. god. (4,9%).

#### *Ključne riječi:*

kemijski parametri, kontaminacija hrane, mikrobiološki parametri