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«TRAINING ACTIVITIES ON FOOD CONTAMINATION CONTROL AND MONITORING WITH SPECIAL REFERENCE TO MYCOTOXINS»

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NATIONAL AND INTERNATIONAL SYSTEMS OF FOOD CONTAMINATION CONTROL WITH SPECIAL REFERENCE TO MYCOTOXINS

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Introduction

The system of measures aimed at the prevention of diseases and public health improvement reserves one of the central places to measures ensuring food safety. Modern human food, due to its multicomponent chemical pattern, besides energy sources, plastics, vitamins, mineral substances and microelements, can involve a whole range of compounds, representing a potential threat to human health. Such compounds primarily include environmentally originated food contaminants: heavy metals, pesticides, nitrates, nitrites, n-nitrosamines, bacteria and bacterial toxins, microscopic (mould) fungi and mycotoxins. It is natural, that environmental contaminants represent the greatest danger for human health, due to their common occurrence in practically all types of foodstuffs of vegetative and animal origins. Mycotoxins are particularly dangerous in view of their ability to affect food products at any stage of production - in the field, during harvest, produce transportation and storage, in the process of food preparation both in industrial and household conditions.

The control of food contamination by foreign agents of chemical and biological origins, and, in particular, by mycotoxins, represents a leading link in the system of food safety measures.

The recent years are characterized by a considerable attention paid by some countries and international organizations to the problems of food safety and increased control of food contamination by foreign agents. The Soviet Union worked out an Agricultural Programme, envisaging national measures on further improvement of food quality, which is being introduced into practice. A number of large-scale programmes on food safety is realized under the auspices of World Health Organization, the UN Food and Agricultural Organization, the UN Environmental Programme.

The present lecture will touch upon most significant questions of organization of control of food contamination with special reference to mycotoxins.

Monitoring of food contamination by mycotoxins; major aims

At present, two levels of organized control of contamination of agricultural raw materials and foodstuffs by foreign agents, and in particular, by mycotoxins; inspection and monitoring, can be conditionally identified. The term "inspection" means the analysis of certain contaminated food products by a definite contaminant during an estimated time

period. "Monitoring" represents a higher organizational level of control and involves a system of regular quantitative analyses of degrees of contamination in respect to both individual foodstuffs, and to the nutrition pattern of a country or its certain region.

The organization of a monitoring system allows to establish the initial level of mycotoxin contamination of agricultural raw materials and foodstuffs and to determine time fluctuations of the above level. Only on the basis of continuous regular observations it is possible to assess the degree of mycotoxin-contaminated food for the population of a given region, to determine the causes and character of fluctuations within a contamination level, to identify food products being the most favourable substrate for the producers of mycotoxins, to confirm the effect of measures resulting in a decreased level of food contamination by mycotoxins, and to prevent the consumption of highly contaminated foodstuffs by the population.

It should be noted, that the monitoring is particularly significant in the analysis of exported or imported agricultural raw materials and foodstuffs. A country, having no systems of monitoring of food contamination by mycotoxins can find itself in a position of a party, importing the produce of low quality, which has not been admitted by other countries. Such a country cannot also guarantee modern requirements of importers of agricultural raw materials and foodstuffs, which to a great degree decreases its export

possibilities. In other words, the organization of a system of monitoring of food contamination by mycotoxins represents an economically profitable measure, because, on the one hand, it guarantees the safety of foodstuffs for a country population, and, ensures the export of high-quality food products, on the other.

It is worthwhile mentioning that in many countries the above described systems of monitoring of contamination of agricultural raw materials and foodstuffs by mycotoxins, and, in particular, by aflatoxins, were initially introduced in respect to the imported produce. A monitoring system is particularly beneficial for the developing countries of Asia, Africa and Latin America, mainly living on the export of agricultural raw materials and livestock fodder.

Laboratory control of food contamination by mycotoxins

Three major stages can be singled out in the system of control of contamination of agricultural raw materials and foodstuffs: sampling for analysis, laboratory analysis of samples and the processing of analytic results.

Sampling for analysis

The sampling and sample preparation for the mycotoxin analysis serves as one of major stages of a monitoring system due to a considerable influence, exerted by the former on the performance of analyses. It should be mentioned, that

usually mycotoxins are identified in high concentrations only in areas of food affection by toxicogenic strains of mycroscopic fungi. Thus, for an adequate assessment of a mycotoxin contamination degree in respect to a lot of agricultural raw materials and foodstuffs, a representative sample is needed, which depends on the type of foodstuffs and on the mycotoxin chemical structure. In view of the ability of mycotoxin producers to affect foodstuffs at any stage of food production, the sampling procedure should be organized at various stages: prior to harvest, during storage, before public consumption. The control of contaminated imported produce is reasonable to organize at the stage of produce importation to a recipient country. During food sampling from lots, it is necessary to take into consideration the following major elements: No. and volume of samples, their homogeneity and quality representativeness.

It should be remembered that for liquid products the sample volume can be smaller than that for bulk products, i.e. grain, flour, etc. The most labour-consuming is sampling for the analysis of aflatoxin content. According to the standards of some countries (e.g. the USA) for the above purpose the lot sampling pattern is as follows:

peanuts - 48 one-pound samples;

Brazil nut - from 20 to 60 one pound samples;

corn grain - 10 one-pound samples;

cotton seeds - 15 four-pound samples;

dried fruits - 50 one-pound samples;

dry milk - 10 one-pound samples.

An important aspect in the preparation of samples for analysis consists in their preliminary grinding and mixing. The selected samples from each lot are pooled together, are thoroughly mixed using mechanic mixers, and are ground. In this way an average sample is selected for the analysis. Laboratory mixers and large powerful grinders permitting to obtain average samples, represent a limiting factor for an adequate sample preparation for the mycotoxin analysis. While assessing the significance of individual components of the summary error in the aflatoxin identification, one can see that in cases of low contamination levels (up to 50 µg/kg) the latter is explained by the sampling error. Thus, for example, when the aflatoxin B_1 concentration in peanuts was 25 µg/kg, the variation factor of the analytic technique constituted only 23%, while at the stage of sampling - 110%. The above high sampling error per cent is explained by a manifested heterogeneity of contamination. For example, it was calculated that the presence of one peanut kernel with high aflatoxin content (1000 mg/kg, the level, which is quite common) among 10 000 normal kernels results in the average 50 µg/kg level of contamination of the sample.

Techniques of control of food contamination by mycotoxins

At present, several types of control techniques in the field of food contamination by mycotoxins are worked out:

screen, quantitative analytic and biological techniques.

Rapid and simple screening techniques, ensure quick and reliable rejection of negative samples. They include a common mini-column technique for the identification of aflatoxins, ochratoxin A, zearalenone, the technique of multidetection of a number of mycotoxins by means of thin-layer chromatography; the fluorescent BGY technique for the identification of aflatoxins in corn, etc.

Quantitative analytic techniques of mycotoxin identification can be subdivided into chemical, immunochemical and immunoenzymic techniques. Chemical techniques involve the stages of isolation and quantitation of mycotoxins. The isolation stage consists of two substages: extraction, i.e. mycotoxin separation from its substrate, and purification, i.e. mycotoxin separation from compounds with similar physicochemical properties. For the purification of mycotoxins usually column chromatography on silica gel, aluminium or florisil, is used, depending on the character of substrate. The final mycotoxin separation is realized by means of thin-layer chromatography on silica gel plates. The use of two-dimentional thin-layer chromatography in various systems of solvents results in adequate mycotoxin separation. High-performance liquid chromatography, gas chromatography and mass spectrometry serve as progressive techniques of detection and identification of mycotoxins. The quantitation of mycotoxins is usually realized by means of direct comparison of the intensity of fluorescent spots on silica gel plates

after thin-layer chromatography in UV light with standards of a known concentration either visually or using densitometric facilities. For higher reliability of the techniques various confirmation tests based on the reception of mycotoxin derivatives with other chromatographic or fluorometric properties, are used. The recent years are characterised by greater attention being paid to the elaboration of highly sensitive and specific immunochemical, radioimmunochemical and immunoenzymic techniques of detection, identification and quantitation of mycotoxins, based on the reception of antisera to mycotoxin conjugates with bovine serum albumin. An advantage of these techniques consists in their extremely high sensitivity, allowing to identify mycotoxins in pictogramme volumes.

Biologic control techniques, which are usually not characterized either by specificity or sensitivity, are used for the identification of mycotoxins, for which there are no chemical techniques of analysis, or as confirmation tests. Various microorganisms, weeds, chick embryos, many experimental animals, are used as test-objects in biological techniques of mycotoxin identification.

It should be underlined that the determination of a degree of contamination of food products and agricultural raw materials cannot be limited only to mycological studies due to the absence of a correlation between the degree of mold fungi affection of foodstuffs and their possible contamination by mycotoxins. It is important to remember, that many

strains of microscopic fungi, isolated from normal foodstuffs, can produce mycotoxins under cultivation in laboratory conditions.

Processing and generalization of analytic results

In the presence of a system of monitoring of food contamination by mycotoxins, the quantitation results related to several mycotoxins in certain forms of food products are directed to superior laboratories, where, if necessary, the arbitration analysis is performed. The analysis and generalization of results are performed by the leading laboratory of a region of a country. In view of different degrees of personnel qualifications of subordinate laboratories, differences in methodological approaches and laboratory facilities, the results of quantitative analysis of mycotoxin content in food products should be subject to statistical processing with the determination of a median and a 90% level of indices, characterizing the actual level of food contamination by mycotoxins. The study of the mathematical distribution of analytic results allows to identify laboratories with extremely high number of erroneous results, and to take corresponding measures to raise the reliability of obtained data.

The information related to the control of contamination of agricultural raw materials and foodstuffs by mycotoxins can be of two types: data requiring urgent preventive measures against mycotoxicoses among the population of a region, and

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the information allowing for the continuous surveillance without any risk to public health. The urgent measures on public health protection in the identification of high levels of mycotoxin contamination include: withdrawal of a food product from public consumption and its disposal or utilization as livestock fodder, the mixing of inadequate product with normal produce, the technological processing resulting in the decreased level of contamination.

In other cases, when the use of urgent measures is not required, the control of contamination of agricultural raw materials and foodstuffs by mycotoxins yields useful information about the very fact of contamination, its level, volume and time characteristics, which allow to determine the growing tendency of contamination, thus, permitting to organize preventive actions before the degree of contamination reaches a level dangerous for the population health. The monitoring system ensures the assessment of the preventive action aimed at the decreased level of food contamination by mycotoxins.

Monitoring of the contamination of agricultural raw materials and foodstuffs by mycotoxins: organizational principles

The problem of contamination of agricultural raw materials, foodstuffs and fodder by mycotoxins is characterized by a number of aspects: medical, social, economic, etc., and

can be resolved only through the combined effort of various Ministries(Ministries of Health, Agriculture, Food Industry, Trade, etc.) and departments. The creation of a country (national) system of monitoring of food contamination by mycotoxins places the responsibility related to planning and control in the hands of one central administrative organ, like, for example, the Ministry of Health, the Ministry of Agriculture or the Ministry of Environmental Protection. It is this organ that should perform the collection, generalization and analysis of the monitoring results, should work out and introduce measures on the prevention of mycotoxicoses and on the decreased food contamination by mycotoxins. The above national organ also realizes the coordination of studies and complex programmes on mycotoxin control with other concerned Ministries. The creation of a working group being entrusted with direct planning, practical realization, assessment and coordination of the monitoring programmes related to food contamination by mycotoxins, within the structure of the above mentioned national organ, is quite expedient. The composition of the working group, besides responsible state officials, should involve the participation of scientists-specialists in various aspects of mycotoxin control.

The organization of an analytical service directly performing the analysis of samples for mycotoxins represents an extremely significant question in the monitoring of food contamination by mycotoxins. It should be borne in mind that

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it is more significant to identify high contamination levels in a maximal number of samples, than to analyze a limited number of samples using highly sensitive and complex techniques. The above principle is particularly significant for countries having limited analytic possibilities. At the same time one should use highly reliable techniques of detection, identification and quantitation of mycotoxins, because the application of "simple" techniques usually results in the increased number of pseudopositive and pseudonegative tests, which is naturally undesirable both from the point of food safety, and in respect to agricultural production economics. The above problems usually find their solution in the creation of a multi-step monitoring system characterized by the growing analytic possibilities of corresponding laboratories; from laboratories using simple screening methods to those equipped with the techniques of high-performance liquid chromatography and chromatomass-spectrometry. The multi-step control system allows to rationalise and utilize sometimes limited personnel resources. With the sophistication of methodological approaches in control laboratories of various levels the personnel performance should rise accordingly; from a laboratory worker using simple quality screening techniques at the initial monitoring stage to a highly qualified investigator, not only capable of the analysis using modern instrumental facilities, but who can also create new and improve the existing analytic techniques at the superior level of the system.

Let us study the principle diagramme of the organization

of a national monitoring system in the field of food contamination by mycotoxins (Diagramme 1). A working group in charge of the organization and direct realization of the whole programme of monitoring of food contamination by mycotoxins is set up at the national organ responsible for the control of food quality. This group guides the activity of the central laboratory and the whole system, collects and analyzes the information coming to the laboratory from inferior levels. The central laboratory, alongside with a research institution responsible for the development of research in the field of mycotoxin control on the national level, introduces into practice the new tested techniques of analysis, works out methodological recommendations and instructions, trains the personnel of regional and local laboratories at the place of work, controls the results of analyses performed by laboratories of the inferior level and, if necessary, organizes arbitration analyses. The bulk of routine analyses for the contamination of food products by mycotoxins is done in regional and local laboratories.

Now how does the monitoring system function? The specially trained personnel of organs of health care, agriculture, veterinary services, i.e. the organs responsible for the control of the quality and safety of foodstuffs, select samples for analysis by standard techniques designed for certain types of foodstuffs, at enterprises of agricultural and food industries, in wharehouses, at markets, institutions of trade and public catering, in places of import of foreign

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produce. In some cases the representatives of local laboratories can perform the quality control by means of corresponding screening techniques directly at the place of sampling. Usually, the analysis of samples for mycotoxins is performed either in local or in regional laboratories. The results of analyses are systematized and are presented to the central laboratory where all data are summarized. The information on the frequency and level of contamination of some foodstuffs and fodder by mycotoxins are statistically processed by the working group and are sent to the national organ responsible for the control of the quality and safety of food products, which, in turn, works out adequate preventive measures aimed at the decreased level of contamination. The practical realization of the above measures is performed through the organs and establishments responsible for the production, purchases and distribution of food produce.

It is necessary to underline that only the existence of the above feedback ensures the effect of the monitoring system, because the control alone can in no way result in the decreased level of food contamination by mycotoxins.

Let us discuss the existing Soviet monitoring system related to food contamination by mycotoxins (Diagramme 2).

The ministry of Health of the USSR and the Ministries of Health of the Union Republics are nationwide state organs responsible for the control of food safety. The Principle Sanitary-Epidemiological Department and its composite Department of Nutritional Hygiene provide guidance to the monitoring

system related to food contamination by foreign agents, including mycotoxins. Sanitary-epidemiological departments entrusted with similar rights are also set up in Republican Ministries of Health. The Institute of Nutrition of the USSR Academy of Medical Sciences represents the national level of research institutions involved in the scientific activity on mycotoxin control. At the Republican level the same functions are performed by various research institutions of the hygienic profile. It is on their basis that the so called scientific-practical centres on the control of food contamination by mycotoxins, corresponding to the level of central laboratories, function. In the USSR there is a broad network of Republican, oblast and town sanitary-epidemiological stations composed of corresponding laboratories of toxicology and nutritional hygiene. The above laboratories realize the direct analysis of food products for mycotoxin contamination. Besides these laboratories, the so called basin sanitary-epidemiological stations controlling mycotoxin contamination of imported food produce, and which are located in the areas of import of food products and agricultural raw materials from foreign countries, were set up. The results of analyses performed in basin, town, oblast and Republican sanitary-epidemiological stations are classified on corresponding levels and are presented to the Principle Sanitary-Epidemiological Department of the USSR Ministry of Health, where, if necessary, preventive measures are worked out. These preventive measures are introduced into the national economy via the Ministries of Agriculture, Food

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Industry, Milk and Dairy Produce, Procurement, Fruit and Vegetable Growing and Foreign Trade. The effects of preventive measures are subject to a regular control from the sanitary-epidemiological service of the country.

Rating of mycotoxin content in foodstuffs and agricultural raw materials; a major preventive measure against alimentary toxicoses and remote mycotoxin effects

Common occurrence of microscopic fungi and their possible affection of agricultural raw materials and foodstuffs at any stage of production makes total prevention of food contamination by mycotoxins practically impossible. At the same time, the organs responsible for the control of quality and safety of food products have a task of preventing the consumption of contaminated food by the population. Hygienic rating of the mycotoxin content in agricultural raw materials and foodstuffs serves as a major means of nutritional protection from foreign agents, including mycotoxins. In recent years we have witnessed a radically increased interest of the specialists in the majority of countries to the problem of maximal permissible levels or concentrations (MPC) of mycotoxins in food produce. A manifested tendency, first, to a larger number of countries officially establishing the MPC for mycotoxins, second, to the increased number of mycotoxins subject to rating, and third, to greater rating differentiation in respect to various types of food and fodder, is

clearly observed (Table 1). The above tendencies are explained, on the one hand, by the incoming additional scientific data and by our broader knowledge of the noxious effect of mycotoxins on the human organism, and, on the other, by further development of analytic techniques of detection, identification and quantitation of mycotoxins in foodstuffs. It should be noted that in the elaboration and establishment of mycotoxin MPCs in food and fodder both the criteria of mycotoxin danger for human health, and possible limitations for the reliable identification of mycotoxins using the analytic techniques, are taked into consideration. As can be seen from data presented in Table 1, by the present time there are about 50 countries who officially established MPCs for aflatoxins. Several countries, besides aflatoxins, also established official ratings for other mycotoxins, representing danger for human health: patulin, ochratoxin A, sterigmatocystin, deoxynivalenol. In many countries, such as Belgium, Columbia, Denmark, USSR, France, Czechoslovakia, Yugoslavia, Japan, and others, differentiated ratings for the aflatoxin content in various foodstuffs and fodder, were specified. A more strict rating norms are designed for babyfood products.

The monitoring of food contamination by mycotoxins ensures continuous control of the degree of mycotoxin contamination related to some foodstuffs without surpassing the official MPC levels. Naturally, corresponding measures guaranteeing total safety of human food should be undertaken each time the MPCs are surpassed.

Assessment of the monitoring effect in the field of mycotoxin contamination of agricultural raw materials and foodstuffs

The indices of chemical purity of the internal human environment serve as the major assessment criterium in the field of food contamination by mycotoxins. In other words, with the introduction of a monitoring system the population of a given region should be guaranteed adequate safety of the internal environment, i.e. the prevention of consumption of mycotoxin-contaminated food.

The analysis, systematization and generalization of control results related to food contamination by mycotoxins allow:

- to prevent human consumption of food products characterized by a high level of mycotoxin contamination;

- to assess remote effects of consumption of mycotoxin-contaminated food on the basis of the calculation of the total amount of consumed mycotoxins during a certain period of time;

- to evaluate the quality of imported agricultural raw materials and foodstuffs, coming, in particular, from countries without self-maintained systems of control of food contamination by mycotoxins;

- to raise the quality of agricultural raw materials and foodstuffs designed for export to other countries;

- to assess the effect of technological and culinary

food processing for the level of mycotoxin contemination;

- to study the correlation dependance between the level of food contemination by mycotoxins in a given region and epidemiological data on the morbidity characteristics among the population.

Alongside with health care aspects the monitoring effect is also determined by economic profit.

International control systems in the field of food contemination by mycotoxins

At present, the problem of mycotoxin control goes beyond the interests of individual laboratories, research institutions and even countries, and is subject to thorough attention of many international organizations: World Health Organization (WHO), the UN Food and Agricultural Organization (FAO), the UN Environmental Programme (UNEP), the International Agency for Research on Cancer (IARC), the Association of Official Analytical Chemists (AOAC), the International Union of Pure and Applied Chemistry (IUPAC), World Veterinary Association (WVA), and a number of others. In the framework of the above mentioned organizations special scientific-practical programmes aimed at the elaboration of problems of environmental protection including the task of of human food safety, are created and develop successfully. Some of the above programmes reserve a significant place to the problem of mycotoxins; e.g. the International Programme on Chemical

Safety (IPCS), the Global Environmental Monitoring System (GEMS), the Monitoring and Assessment Research Centre (MARC), the Joint FAO/WHO Food Standards Programme. The Collaborating FAO/WHO Centres on monitoring of food contamination by foreign substances, including mycotoxins, are set up and function in the framework of FAO and WHO (Table 2).

The above meantioned international programmes envisage:

- assistance to national organizations in the establishment and development of monitoring systems related to the contamination of agricultural raw materials, foodstuffs and fodder by mycotoxins;

- creation of an international coordination centre on collection and storage of analytical results obtained within the framework of national systems of monitoring of mycotoxin contamination of agricultural raw materials, foodstuffs and fodder;

- provision of data to the national organizations on the assessment of food contamination by mycotoxins related to human health;

- review, assessment and distribution of the monitoring data related to mycotoxin contamination of agricultural raw materials, foodstuffs and fodder;

- international coordination of research activities on the problem of mycotoxin contamination of agricultural raw materials, foodstuffs and fodder, particularly in the field of sampling, techniques of analysis and establishment of food chains;

- development of research to work out international standards in the field of MPCs for mycotoxins related to various types of food products and fodder;

- planning national control programmes in the field of mycotoxin contamination of food and fodder on the international level, taking into account the decreased danger of food contamination and hence induced economic damage.

In the FAO/WHO framework regular seminars on the organization and management of food control services, aimed, inter alia, at the unification of the existing food legislature in various countries, at the elaboration of concrete measures, pertaining to the organization of the service, its financial conditions, personnel training, provision of laboratory facilities, at the creation of an informational (reference) service, at the unification of analytic techniques and forms of registration of obtained results, are organized.

In the framework of such international organizations as WHO, FAO, IARC and IUPAC the Special Programme involving the use of test samples of mycotoxins, and, in particular, aflatoxins, aimed at the improvement of the international and national systems of control of mycotoxin contamination of agricultural raw materials, foodstuffs and fodder, and at higher quality of analytic results, was created. In 1981-1983 alone, over 130 laboratories from many countries of the world took part in the interlaboratory testings of techniques of aflatoxin identification, while over 50 laboratories studied the above techniques in respect to ochratoxin A. One

should note that the Programme coordinators regularly analyze the whole information and subject it to statistical processing, comparing the sensitivity and reliability of various mycotoxin quantitation techniques, distribute the above data and recommendations among the Collaborating FAO/WHO Centres on the problem of monitoring of food contamination by mycotoxins.

The extreme significance and high efficiency of the involvement of international organizations in the creation and functioning of the Global Monitoring System related to mycotoxin-contaminated agricultural raw materials and foodstuffs, can hardly be overestimated. The activity of the above organizations favours considerably the concentration of efforts in the solution of this complex and multi-faceted problem both in developed and developing countries.

Diagramme 1. Recommended organizational framework for a national monitoring system related to food contamination by mycotoxins.

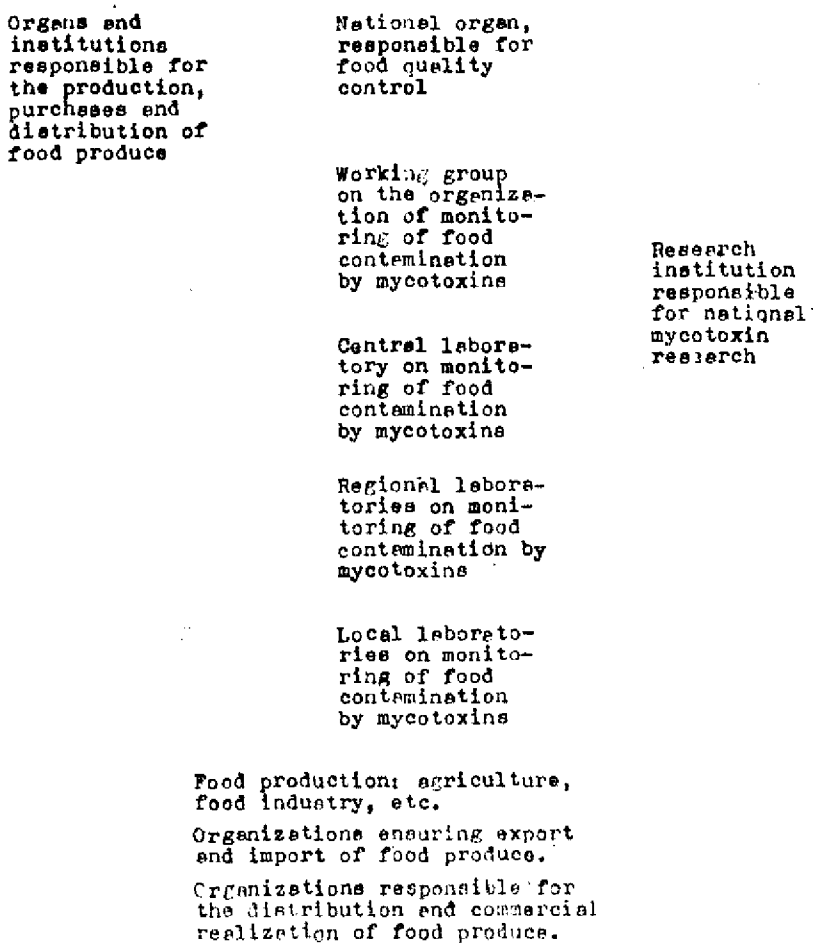

Diagramme 2. The existing Soviet system of monitoring of food contamination by mycotoxins.

Ministries responsible for production and import of food produce:

Ministry of Agriculture;
Ministry of Food Industry;
Ministry of Milk and Dairy Produce;
Ministry of Procurement;
Ministry of Fruit and Vegetable Growing;
Ministry of Foreign Trade.

Ministry of Health of the USSR

Principle Sanitary-Epidemiological Department

Ministries of Health of Union Republics

Sanitary-Epidemiological Departments

Republican sanitary-epidemiological departments

Oblast, town and basin sanitary-epidemiological stations

Institute of Nutrition of the USSR Academy of Medical Sciences; the National Scientific-Practical Centre (Laboratory)

Food production: agriculture, food industry, etc.

Organizations of the USSR Ministry of Foreign Trade, responsible for export and import of food produce.

Organizations and institutions of the USSR Ministry of Foreign Trade, responsible for food commercial operations; establishments of public catering.

Table 1. Official maximal permissible concentrations (MPC) of mycotoxins in food and fodder, established in various countries.

Country	Mycotoxin	Type of produce	MPC (µg/kg)
1	2	3	4
Australia	Aflatoxins	All food products	5.0
Austria	-"-	All types of fodder	50.0
Belgium	-"-	All food products	5.0 (B_1)
		Milk and dairy products	1.0 (M_1)
	Patulin	All food products	0
	Ochratoxin A	-"-	0
	Sterigmato-cystin	-"-	0
	Zearalenone	-"-	0
Brazil	Aflatoxins	Peanut meal (export)	50.0
Canada	-"-	Nuts and nut produce	15.0
	Deoxynivalenol	All cereals for babyfood	0
Columbia	Aflatoxins	Peanuts, seesame, cereals, sorgo	10.0; 20.0 30.0
Cuba	-"-	Cereals, peanuts	0
Denmark	-"-	Peanuts and peanut produce	10.0
		Various types of fodder	10.0-50.0 (B_1)
	Ochratoxin A	Pork Kidneys, liver	25.0 10.0

Table 1 (cont.)

1	2	3	4
Dominican Republic	Aflatoxins	Corn and corn produce	0 (B_1 + G_1)
		Various types of fodder	30.0
Federal Republic of Germany	-"-	Peanuts and peanut produce, other oils and nuts	20.0 or 5,0 B_1
		Various types of fodder	10.0-50.0 (B_1)
Finland	-"-	Nuts and nut produce	5.0
France	-"-	All food products	10.0
		Babyfood	5.0
		Dietary dairy products	0.024 ug/ 100 Kjoules
		Various types of fodder	10.0-50.0(B_1)
Great Britain	-"-	Nuts and nut produce	5.0 (B_1)
		Various types of fodder	10.0-50.0(B_1)
Greece	-"-	Various types of fodder	10.0-50.0(B_1)
Hong Kong	-"-	All food products	15.0
India	-"-	Peanut meal (food)	30.0
		Peanut meal (fodder)	1000.0
Ireland	-"-	Various types of fodder	10.0-50.0 (B_1)
Israel	-"-	All types of fodder	20.0
Italy	-"-	Peanuts	50.0

Table 1 (cont.)

1	2	3	4
Japan	Aflatoxins	All food products	10.0 (B_1)
		Fodder peanut meal (import)	1000.0 (B_1)
Jordan	-"-	Various types of food and fodder	15.0 or 30.0
Kenya	-"-	Peanuts and peanut produce	20.0
Luxembourg	-"-	Peanuts and peanut produce	5.0 (B_1)
		Various types of fodder	10.0-50.0(B_1)
Malawi	-"-	Peanuts (export)	5.0 (B_1)
Malaysia	-"-	All food products	0
Netherlands	-"-	Peanuts and peanut produce	5.0 (B_1)
		Liquid milk	0.1 (M_1)
		Various types of fodder	10.0-50.0(B_1)
New Zeland	-"-	All imported food	15.0
		Pea (export)	5.0
Nigeria	-"-	Food produce (export)	MPC of importing countries
Norway	-"-	Peanuts, Brazil nut	20.0 or 5.0(B_1)
		Fodder (peanut grist, coconut grist, corn)	50.0
	Patulin	Apple juice (concentr.)	50.0
Philippines	Aflatoxins	Peanut and coconut produce (export)	20.0
Poland	-"-	All food products	5.0(B_1)
Portugal	-"-	Peanuts	

Table 1 (cont.)

1	2	3	4
Singapore	Aflatoxins	All food products	10.0-15.0
South African Republic	-"-	All food products	10.0 or 5.0(B_1)
Surinam	-"-	Peanuts and peanut produce	5.0 (B_1)
Switzerland	-"-	Food produce	5.0 or 1.0 B_1
		Milk and dairy produce	0
	Patulin	Apple juice (concentr.)	50.0
Sweden	Aflatoxins	All food products	5.0
		Whole nuts	20.0
		Fodder	600.0
	Patulin	Apple juice (concentr.)	50.0
Thailand	Aflatoxins	Food oils	20.0
USA	-"-	All food and fodder	20.0
		Liquid milk	0.5 (M_1)
USSR	-"-	All food products	5.0
		Milk and dairy produce	0,5 (M_1)
	Patulin	Fruit and vegetable juices and concentrated puree	50.0
		Same for babyfood	20.0
Yugoslavia	Aflatoxins	Cereals	1.0(B_1+G_1)
		Leguminous and nuts	5.0(B_1+G_1)
		Peanuts	10.0(B_1+G_1)

Table 2. Collaborating Centres for Joint FAO/WHO Food and Animal Feed Contamination Including Mycotoxins Monitoring Programme

Country	Research Institution, Institute
Australia	Food Administration Australia Commonwealth Department of Health, Woden.
Austria	Ministry of Health and Environmental Protection, Vienna.
Brazil	Instituto Adolfo Lutz, Sao Paulo.
Canada	Food Directorate. Health Protection Branch. Department of National Health and Welfare, Ottawa.
Denmark	National Food Institute, Soborg.
Egypt	Sanitary Chemistry Laboratories. Central Laboratories General Administration. Ministry of Health, Cairo.
Germany, Fed. Republic of	Centre for Surveillance and Evaluation of Health Hazards by Environmental chemicals, Berlin (West).
Guatemala	United Food and Drug Control Laboratory, Guatemala City.
Hungary	Department of Toxicological Chemistry. Institute of Nutrition, Budapest.
Ireland	Department of Agriculture. Agriculture House, Dublin.

Table 2 (cont.)

Country	Research Institution, Institute
Japán	Food Division. National Institute of Hygienic Sciences, Tokyo.
Kenya	National Public Health Laboratory. Ministry of Health, Nairobi.
Mexico	Subsecretaria de Mejoramiento del Ambiente. Secretaria de Salubridad y Asistencia, Mexico.
Netherlands	National Institute of Public Health, Bilthoven.
New Zeland	Food Section. Food and Nutrition Branch Division of Public Health. Department of Health, Wellington.
Poland	Department of Food Research National Institute of Hygiene, Warsaw.
Quater	Regional Centre. Food Contemination Monitoring, Doha
Sweden	Toxicology Laboratory. National Food Administration, Uppsala.
Switzerland	Federal Office of Public Health. Food Control Division, Bern.
UK	Food Science Division. Ministry of Agriculture Fisheries and Food, London.
USA	Bureau of Foods. Public Health Service. Food and Drug Administration. Department of Health and Human Services, Washington.
USSR	Institute of Nutrition. Academy of Medical Sciences, Moscow.

RECOMMENDED LITERATURE

1. Brewer D., Teyler A., Evens A. A Mechenical Search and Retrieval System for Mycotoxins. Proc. Nova Scotian Inst. Sci., 1978, 28, No. 3-4, 163-169.
2. Campbell A.D. Food mycotoxins survey and monitoring programmes. Ann. Nutr. Alim.,1978, 31, 403-410.
3. Ciegler A. Control Measures for aflatoxin contamination of agriculture commodities. Ann. N.Y. Aced. Sci., 1979, 329, 285-292.
4. Cooper S. An assessment of the risk from mycotoxin contamination of food. Chem. Ind. (London), 1982, No. 24, 977-979.
5. Environmental Carcinogens Selected Methods of Analysis, vol. 5, Some Mycotoxins, IARC Scientific Publications No. 44, Lyon, 1982.
6. Environmental Health Criteria 11. Mycotoxins. Pub. UN Environmental Programme and the WHO, WHO, Geneva, 1979.
7. FAO/WHO Joint Expert Committee on Food Additives. Evaluation of certain food additives and contaminants. Twenty-sixth report of Joint FAO/WHO Expert Committee on Food ed., WHO, Techn. Rep. Ser., 1982-683, 51 p.
8. Food Control Laboratories. Report on a Conference Copenhagen, 24-28 October, 1977, Regional Office for Europe, WHO, Copenhagen.
9. Friesen M. Quality Assurance for Mycotoxin Analysis: Mycotoxin Check Sample Programmes, Environmental Carcinogens Selected Methods of Analysis, Vol. 5, Some Mycotoxins

IARC Publications No. 44, IARC Lyon, 1982, p. 85.

10. Health Aspects of Chemical Safety, Interim document 4, Laboratory Quality Control WHO, Regional Office for Europe, Copenhagen.

11. Joint FAO/WHO Food Standards Programme Recommendations for Methods of Analysis for Pesticide Residues (Codex Alinorm 83/24- Add.1) with as Annex, Recommended Methods of Sampling for the Determination of Pesticide Residues (Codex Alinorm 79/24, Appendix IV, Annex 1). Technical Monograph No. 6, 1982, FAO.

12. Kravchenko L.V., Tutelyan V.A. Organization of the Control over Food Contamination with Mycotoxins. J. Vopr. Pitanya, 1982, No. 5, 23.

13. Perspective on mycotoxins (selected documents of the Joint FAO/WHO/UNEP Conference on Mycotoxins held in Nairobi, 19-27 September 1977), FAO, Rome, 1979.

14. Summary and Assessment of data received from the FAO/WHO Collaborating Centres for Food Contamination Monitoring. UN Environmental Programme, FAO, WHO, National Food Administration, Uppsala, 1982.

15. Tutelyan K.A. Toxic Substances in Food and the Risk for Human Health, J. Vopr. Pitanya, 1983, No. 6, 10-17.

16. Vesonder R.f. Natural occurence (of trichothecenes) in North America. Dev. Food. Sci., 1983, 4, 210-217.

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