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

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EXPERIENCE OF THE REPUBLICAN  
(REGIONAL) CENTRE ON RESEARCH  
AND CONTROL OF MYCOTOXIN  
CONTAMINATION



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CONTROL OF FOOD CONTAMINATION BY NATURAL AGENTS:  
ACTIVITY OF THE REPUBLICAN (REGIONAL) SCIENTIFIC  
AND PRACTICAL CENTRE

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Kazakhstan represents a large granary and a significant animal husbandry basis of the Soviet Union. From a land of almost total illiteracy Kazakhstan developed into a Republic characterized by a high level of science and culture, having dozens of institutions of higher education and research. Followed by deep socio-economic changes, health care became an integral part of state and public measures on the prevention and treatment of diseases, on the ensurance of healthy conditions of work, higher working abilities and increased active life span.

A preventive, socio-hygienic approach is one of basic principles of Soviet health care. In the USSR, prevention of diseases does not represent a limited departmental task of health care organs. It is a system of state and public measures, aimed at the elimination of dangerous environmental factors, affecting human health, at the creation of conditions, maximally limiting the possibilities of occurrence of diseases: provision of housing, hygiene of nutrition, healthy conditions of work, reduction of a working day, ensurance of an adequate number of places for all children in childrens' establishments, development of physical culture and

sports, creation of rest facilities, etc.

Soviet health care is based on the unity of medical science and practice. A network of sanitary-epidemiological services in Kazakhstan is represented by the Principle Sanitary-Epidemiological Department of the Ministry of Health of the Kazakh SSR, by the Republican House of Health Education, by a network of sanitary-epidemiological stations (including the Republican, 19 oblast and over 290 urban and rayon (district) SES) and by other organs.

The material and technological basis of the sanitary service is constantly consolidated. Only during the last several years the Republic witnessed the opening of new 17 sanitary-epidemiological stations, the construction of 10 new buildings of sanitary-epidemiological stations and 8 laboratory blocks; before 1985 75 sanitary-epidemiological stations and laboratory blocks are to be planned and constructed.

About 28 000 medical workers are engaged in the establishments of Republican sanitary services, including 3 500 physicians and 17 800 feldschers and nurses. Annually the sanitary-epidemiological service is replenished by 280 physicians and by over 500 feldschers and nurses. The qualification status of sanitary workers constantly raises; annually, over 450 physicians upgrade their qualification, in particular, in the field of hygiene of nutrition.

The major tasks of organs and establishments of the sanitary-epidemiological service in the Republic consists in the control of the fulfillment of sanitary-epidemiological measures and sanitary-antiepidemic norms and rules by state organs, enterprises, organisations, official representatives and individuals concerned with sanitary and epidemiologic activities.

In Kazakhstan, the activity of sanitary-epidemiological stations in the field of hygiene of nutrition is carried out in the following directions:

1. Preventive sanitary surveillance of the construction and reconstruction of enterprises of food industry, public catering, commercial and other installations.

2. Elaboration and control of sanitary measures related to the use of pesticides in agriculture and to the introduction of new polymers and plastics in the food industry, enterprises of public catering, in commercial and household conditions.

3. Hygienic analyses of food products in view of their contamination by mycotoxins.

4. Control of the use of food additives, colorings, preserving agents, stabilizers, emulsifying substances, aromatizers, etc.

5. Organization of measures on rational nutrition on the basis of recent achievements of the nutritional science and on principles of preventive nutrition for individuals working

in contact with noxious substances.

6. Toxic-hygienic studies of foodstuffs, produced from new raw materials by means of new technological facilities.

7. Control of the quality of agricultural produce, harvested on irrigated lands, due to broader use of run-off for irrigation.

8. Systematic routine sanitary surveillance of the functioning food enterprises.

9. Elaboration and organization of measures on the prevention of food poisonings.

The preventive approach in the field of hygiene of nutrition is most effectively realized within the system of state preventive sanitary control of food enterprises. This involves timely introduction of scientifically motivated sanitary-hygienic and organizationally-technical decisions on the production of a wide range of adequate foodstuffs already at the stage of planning, construction and reconstruction of food enterprises, and permits to ensure timely identification and prevention of sanitary disorders.

In accordance with the Statute on State Sanitary Control, approved by the Enactment of the USSR Council of Ministers, - "The Instruction on the work of a sanitary-epidemiological station in the field of hygiene of nutrition", and by "The Fundamentals of Legislation of the USSR and the Union Republics on Health Care", a sanitary physician studies the documentation on construction areas for food industry enterprises, public catering places, commercial and storage installations

of food blocks in curative and preventive institutions, and gives his (hers) recommendations. The above physician is guided in his (hers) work by such documents as "Planning and building of human settlements. Planning norms" and "Sanitary norms and rules for concerned food enterprises". When a construction site is chosen, protective land zones, terrestrial relief, ground water table, type of soil and possibility of its contamination by pathogenic microorganisms, helminthic ovi or dangerous organic and chemical agents, are taken into consideration.

All installations under construction and reconstruction have special maps of preventive sanitary surveillance, which are compiled directly after the elaboration of a project. Constructed installations are put into operation obligatorily in the presence of representatives of the sanitary-epidemiological service.

Besides, to ensure preventive sanitary control, hygienic assessment and sanitary examination of new types of foodstuffs, utensils, containers, packing materials and food industry hardware, are performed.

The organs of state sanitary surveillance constantly pay attention to questions of food safety from contamination by some foreign agents representing a potential threat to human health, such as: pesticides, some compounds of heavy metals (cadmium, lead, mercury), carcinogenic n-nitrosoamines, mycotoxins, etc.

A great interest to the above mentioned compounds is

determined by their confirmed potential danger to human health. In particular, a manifested carcinogenic effect is found in volatile n-nitrosoamines, in a whole range of mycotoxins (aflatoxins, patulin, sterigmatocystin, etc.). Compounds of mercury, lead and other heavy metals are known to possess potent embryotoxic, teratogenic properties. Pesticides are commonly known for their toxicity. Hence, the necessity to organize an adequate system of control of food safety from contamination by foreign agents.

It should be underlined, that the organs of state sanitary control adequately elaborated an effective system of control of contaminants, while the Republican sanitary-epidemiological stations annually pursue a great number of studies on the identification of contaminants in foodstuffs.

A lot is done to prevent cases of intoxications. As a result of undertaken measures, food poisonings, resulting from consumption of foodstuffs contaminated by foreign agents, including toxic chemicals, have not been registered for a number of recent years.

Among foodstuffs the produce of vegetative origin (vegetables, fruits, berries) grown on the territory of controlled agricultural plots represents the major significance for the analysis. The content of toxic chemicals in the above produce corresponds to the norms of means of chemical protection of plants, applied on agricultural lands, and to the list of chemical and biological means of control of pests, plant diseases and weeds, recommended for annual use

in farms. The list of chemical and biological means of control is approved by the Ministry of Agriculture followed by an approval by the Ministry of Health.

The laboratory identification of residual amounts of foreign agents in foodstuffs involves the use of various methods of analysis: calorimetric, spectrophotometric, chromatographic, etc.

In the early years of organized control of contaminants in foodstuffs, when the maximally permissible levels had not yet been worked out for some foreign agents, and concrete contamination control measures had not yet been elaborated, the foodstuffs contained a large per cent of residual amounts of contaminants, sometimes exceeding the permissible level.

In recent years, the level of residual toxic chemicals in vegetables and fruits has decreased considerably, which testifies to the raised culture of work with toxic chemicals.

5 intraoblast toxicological laboratories on the control of residual foreign agents, including pesticides, in foodstuffs, servicing 4-9 adjacent oblasts, were created in the Republic. Of all the analyses performed for the presence of residual foreign agents 60% involve the study of foodstuffs. These laboratories annually perform the analysis of over 20 000 samples of various foodstuffs.

Various synthetic, polymer and plastic products have been quite common in recent years in the industry and human daily life. The food industry utilizes polymer produce as



packing containers, package films, combined packing material, disposable packing, parts of food industry machinery, polymer paint and varnish coatings, synthetic glue and rubber. Coming in contact with foodstuffs these substances can produce a complex of noxious chemical compounds forming a result of incomplete processes of polymerization and destruction. This forced to introduce special measures raising the level of state sanitary control. Intraoblast toxicological laboratories perform sanitary and hygienic examination of new chemical substances, give sanitary and hygienic assessment of polymer materials, plastics and products made from these materials. Corresponding hygienic recommendations on production and use of such materials are worked out on the basis of examination results concerning new polymers and polymer produce. Measures on health improvement of work conditions, on environmental protection, on the prevention of diseases of chemical etiology, are realized.

In the USSR, according to the Statute on State Sanitary Control only the organs of sanitary control can allow for the production and use of new types of utensils, containers, equipment and packings. The work is performed on the basis of the "Instruction on sanitary chemical analysis of polymer and other synthetic products designed for contact with foodstuffs".

The results of analyses in the form of conclusions are sent to the Intradepartmental Committee on the Study and Hygienic Standardization of Polymer Materials, where the

samples are studied and are directed to the USSR Ministry of Health for the final admission.

The use of various chemical agents and natural compounds prolonging the period of storage, accelerating the technology of production and improving the quality of foodstuffs, is quite common in all countries.

In the USSR, not a single food additive can be used by the food industry until an official permission of the organs of the sanitary-epidemiological service is provided.

Food additives should meet even stricter safety requirements than those applied to admixtures, i.e. they should be safe at all concentrations.

The Ministry of Health adopted special sanitary norms on the use of food additives, the safety of which is ensured by a thorough preliminary toxico-hygienic analysis and determination of permissible residues of such agents in foodstuffs.

The use of food additives does not impair the nutritive value of foodstuffs, resulting in longer periods of storage, better organoleptic properties and easier technological processing.

The list of food additives is subject to periodic revision, when the admissible limits can be changed depending on recent scientific data. Before introducing any new food additive the administration of an enterprise should obligatorily inform the local sanitary organs about its decision and should obtain a permission from the latter.

Practical physicians on nutritional hygiene ensure a continuous control of the use of new food additives on the basis of existing sanitary regulations and technological norms.

In the organization of foodstuff quality control routine sanitary food surveillance represents one of major and significant elements. In this activity sanitary physicians are guided by the existing sanitary legislature and basic methodologies of sanitary services.

A sanitary physician controls the observance of industrial sanitary norms, studies the morbidity of workers, improves their working and environmental conditions, ensures the fulfillment of sanitary and hygienic rules and norms in the process of storage, preparation and distribution of food produce, in the organization of disinfection and deratization measures and installations' up-keep.

Unobservance of sanitary rules within a food unit, improper storage of foodstuffs can seriously endanger human health. Thus, sanitary physicians on nutritional hygiene bear a great responsibility requiring constant improvement of organizational techniques, laboratory control, etc.

The sanitary-hygienic laboratories of sanitary-epidemiological stations annually perform up to 40-45 thousand analyses of daily meals, precooked foodstuffs for calory and vitamins content.

The routine sanitary surveillance is periodically organized. The periods of control visits depend on the signi-

ficance of an installation, its hygienic status, concrete local conditions, season, epidemic situation, etc.

For a precise registration of controlled units, a list of all food enterprises, which is systematically revised and replenished, is compiled by the sanitary-epidemiological stations.

Besides, there is a file of installations or sanitary certificates, into which all data about a food enterprise are registered: title of an establishment, address, telephone number, industrial capacity, No. of personnel subject to medical services and other data. The file reflects dynamic changes of an establishment.

Control visits of food enterprises of one profile became quite popular in the Republic. The materials of the above visits are generalized and are sent to concerned institutions and departments with concrete proposals on the results of such visits. Besides, complex examinations with the participation of various SES specialists (physicians-epidemiologists, parasitologists, specialists on communal hygiene, etc.) and also specialists of related professions (veterinary service, quality inspection, engineers-technologists on nutrition, etc.), are organized.

The activity of sanitary-epidemiological stations in the field of hygiene of nutrition is closely related to the solution of such tasks as prevention of food poisonings and acute intestinal diseases. Other concerned departments are involved in the above activity. Future complex plans

on the improvement of material and technological basis of food enterprises, on increased sanitary culture, on prevention of food poisonings and acute intestinal diseases, are worked out in the Republic. The fulfillment of measures on the above plans are subject to a systematic control.

High biological value of milk and dairy products makes them totally indispensable as food components. Milk and dairy products should obligatorily come part of daily nutrition. Milk is particularly important for children, elderly persons and patients.

At the same time, milk is a perishable product, thus, its safe consumption can be ensured only under proper organization of antiepidemic and hygienic measures, combined with control at all stages of collection, processing and distribution.

The Ministry of Agriculture and a number of other departments organized a complex of measures aimed at the improvement of milk quality indices. Instead of small dairy farms, large-scale animal husbandry complexes for 800-1200 and more heads of cattle are annually constructed and put into operation on the basis of typical projects. These complexes are provided with modern technological equipment and are maximally mechanized. These complexes resolved questions of adequate cold and hot water supplies, sewage and manure disposal, primary processing, filtration and mechanical cooling of milk, etc. Kazakhstan is characterized by great distances separating summer rangelands from farms,

which creates some difficulties in the field of primary milk processing and its transportation.

To raise the quality of milk produce the material and technological basis is continuously improved, the equipment is substituted for new one or is modernized, new technological processes, progressive methods and means of control of the produce quality, improved sanitary regime of enterprises, increased output of products in ready or packed form, are introduced.

At present, the dairy industry in the Republic has a task of concentrating its production. Large enterprises, capable of processing 250 and over tons of milk per shift, are constructed in the Republic. Plants of dry defatted milk and whole milk substitutes are put into operation.

The introduction of new technological processes, like milk purification by means of milk-purifying separators with mechanical sediment rejection, milk and cream deodorization, preparation of cheese using the fermentation compound No. 2 and anastogenetic fermenting agents, found its broad application.

At many enterprises the production of sour-milk products by the reservoir technique in closed stream, which prevents secondary contamination of ready produce, was introduced into practice.

At milk processing farms there are 98 microbiological laboratories, ensuring biological control of all dairy plants, cheese factories and some of butter-producing farms

of the Republic.

The control of foodstuffs should be motivated by sanitary-hygienic measures. This forces to broaden the volume of laboratory investigations, and introduce new forms and means of work by SES laboratories.

In recent years, over 1.5 mln. hygienic studies (out of which 30% concern food analyses) are annually performed in the Republic. The examination of food installations of the Republic with the use of laboratory and instrumental techniques is performed in 51% of cases, while in some oblasts - in 61.7 - 70%.

Physico-chemical methods of study (polarographic, chromatographic, photometric) are still more common; express-packings are introduced into the practice of food inspection officials.

The laboratories of hygiene of nutrition study the quality of pasteurization and vitamin "C" content, the daily food intake of organized groups of the population, the degree of oxidation of frit fat, the quality of thermal processing of precooked meals, organize hygienic examination of utensils, containers, packing materials. Other types of investigations of the quality of food products are performed in accordance with the requirements of standard technological documentation: state and Republican standards, technical conditions, etc.

Sanitary-bacteriological control represents a significant auxiliary method in the practice of sanitary surveil-

lance in the field of nutritional hygiene, one of the tasks of which is to study the routes of infection transmission.

After processing and detailed analysis the materials of sanitary-bacteriological studies resulting from mass examinations of single-type installations serve as basis for individual sanitary and hygienic norms related to the presence of microflora in the studied samples.

The volume of sanitary-bacteriological analyses of foodstuffs constitutes 20% of all investigations of environmental objects.

The character and contents of sanitary-bacteriological control is determined by the activity of the departments of hygiene of nutrition and depend on the specificity and epidemiologic situation of a territory, on the presence and conditions of food industry enterprises, institutions of public catering, their material and technological basis, etc. The practical activity of Republican sanitary-epidemiological stations showed that farms producing and processing milk and enterprises producing baby food, deserve particular attention from the point of sanitary-bacteriological control. 35% of all bacteriological analyses of foodstuffs are devoted to the above types of investigations.

Kazakhstan is a highly industrial Republic, represented by mining, chemical, metallurgical, machinebuilding and other industrial branches, where the work is connected with the effect of a number of hazardous factors and requires systematic rehabilitation of energy losses of the human orga-



nism, the maintenance of human ability to work, the preservation of high resistance to dangerous environmental factors. This can be attained by an adequate organization of rational and preventive nutrition of various workers.

When a biologically valuable food diet is formulated, the calory content, qualitative composition, the balance of nutritive substances, their digestibility, organoleptic properties and diversity of food elements, their structure and saturability, food products combinations and sanitary-epidemiological safety, are taken into consideration. While determining a regime of nutrition, hours and duration of meals, intervals between meals and amount of food consumed, the consequence of meal courses and daily food distribution patterns, are specified.

The Institute of Nutrition of the USSR Academy of Medical Sciences worked out special diets meeting nutritional requirements of miners, workers of the chemical industry, forge shop and agricultural workers, etc.

Workers engaged in hazardous occupations (chemical substances) are entitled to 1 out of 5 treatment-preventive diets free of charge.

The list of occupations the work at which gives the right to free treatment-preventive meals covers a number of professions and posts in the chemical, metallurgical, electrotechnical, radiotechnical and other branches of industry.

Speaking about present achievements, it is necessary to remember the time when in 1979, to improve control of the

quality of foodstuffs, the Ministry of Health of the Kazakh SSR performed a thorough analysis of the activity of State sanitary control organs in the field of hygiene of nutrition to identify most significant contaminants of agricultural produce in various climatic and geographical zones of the Republic. For generalization purposes, not only the data of practical establishments were used, but also the long-term experience of hygienists from the Institute of Nutrition of the USSR Academy of Medical Sciences and its Kazakhstan branch, was taken into consideration.

While preparing and elaborating the initial data we followed the existing recommendations by FAO, WHO, UNEP, relative to the list of the so-called major (prioritive) food contaminants.

The initial data on most common food contaminants were diverse and sometimes controversial. While for pesticides, nitrates, nitrites, heavy metals, the practical units of the sanitary-epidemiological service possessed an adequate volume of information, for other foreign agents, however (primarily for n-nitrosocompounds, mycotoxins, etc.), we had to apply to Research Institutes of hygienic profile, and in particular to the Institute of Nutrition of the USSR Academy of Medical Sciences and its Kazakhstan Branch. Having obtained the necessary material and having subjected it to preliminary analysis, we began compiling a map of most common contaminants, representing a real threat for various regions of the Kazakh SSR. We identified areas with relatively high

levels of foodstuff contamination by foreign agents. Besides, the obtained results permitted to draw a conclusion that practically all groups of contaminants are significant for Kazakhstan taken as a whole. On the other hand, the occurrence of such contaminants in foodstuffs was differentiated for various regions of the Republic.

For example, attention was paid to the fact that a relatively high content of heavy metal salts in foodstuffs of vegetative origin was observed in southern and south-eastern regions of Kazakhstan in contrast to other areas of the Republic. This seemed to be due to an increased environmental and soil content of the above chemical elements in these regions.

In western and particularly central regions of Kazakhstan the level of mycotoxins was elevated, which can be attributed to peculiar climatic conditions of these zones.

Thus, our analysis confirmed the necessity to improve the State Control System related to the level of foreign agents contamination of major agricultural food products.

Thus, it was proved reasonable to establish regional specialized centres on identification, detection and quantitation of major contaminants of foodstuffs, common for a given locality, on the basis of local oblast sanitary-epidemiological stations. To this aim, in 1980, on the basis of an intraoblast toxicological laboratory of the Alma-Ata town sanitary-epidemiological station, the Republican Scientific and Practical Research Centre on Control of food con-

tamination by foreign agents, was set up, having the following tasks:

- testing and introduction of new perspective techniques of detection, identification and quantitation of foreign agents in foodstuffs into the practice of local sanitary-epidemiological stations;

- mastering of the above techniques by the specialists of regional sanitary-epidemiological stations at their place of work under corresponding control;

- creation and testing of uniform methods to obtain comparable results;

- performance of arbitration analyses, particularly in cases of identification of contamination levels considerably exceeding the MPC.

However, the major task of the Centre consists in the collection, generalization of data and the analysis of levels of actual contamination of various foodstuffs by foreign agents and the elaboration of proposals aimed at the decrease of such contamination on the basis of the obtained data. The obtained materials are then transmitted to the governing organ of the Ministry of Health of the Republic for the elaboration of hygienic measures; proposals, recommendations and, sometimes, demands to reduce the level of contamination of foodstuffs are sent to superior administrative organs. The effect of measures undertaken is assessed.

A concrete example: during the last 2.5 years our Centre specializes on the study of food contamination by vegetative

mycotoxins, in particular, by aflatoxins. For the preliminary analysis we selected 3 regions with a number of oblasts located in southern, western and central districts of the Republic, which represent major producers of wheat and corn grain.

We are particularly interested in the study of contamination of corn grown in the Republic and which is commonly used as livestock fodder. Corn is known to possess one of most favourable substrates for the producers of aflatoxins.

Our Centre introduced the techniques of detection and identification of aflatoxins B<sub>1</sub>, B<sub>2</sub>, G<sub>1</sub>, G<sub>2</sub> while about 2500 analyses of wheat, corn, vegetables, melons and water melons, meat and dairy products were performed.

Let us discuss the elements of work organization in the Centre together with the data on the frequency and levels of aflatoxin contamination of some foodstuffs coming from various districts of Kazakhstan.

Grain samples were taken at various granaries of the Alma-Ata and Dzhambul oblasts. The aflatoxin content was determined by the technique of thin-layer chromatography.

For the identification and quantitation, crystal compounds of aflatoxins B<sub>1</sub>, B<sub>2</sub>, G<sub>1</sub> and G<sub>2</sub> produced by the Company "Sigma" (USA), were used as standard. The presence of aflatoxins was determined visually by comparing the fluorescence intensity of identified aflatoxin spots. 65 corn samples, 37 wheat samples, 11 samples of barley, 8 millet samples, 19 rice and 20 combined fodder samples, were studied out of 160 analysed grain samples of the 1980 harvest.

The fact of aflatoxin presence in a rather large per cent of analyzed samples of combined fodder (60) and corn (4), deserves attention.

In one corn sample the aflatoxin B<sub>1</sub> concentration reached 820  $\mu\text{g}/\text{kg}$ . In 5.4% of wheat samples, aflatoxin B<sub>1</sub> was identified in doses of up to 10  $\mu\text{g}/\text{kg}$ .

Of interest is the fact that aflatoxin B<sub>1</sub> is mainly found in grain, however, we were first to obtain data, testifying to the contamination of several corn samples also by aflatoxins B<sub>2</sub>, G<sub>1</sub>, G<sub>2</sub>. For example, aflatoxin B<sub>2</sub> was found in a concentration of 10  $\mu\text{g}/\text{kg}$ , while aflatoxins G<sub>1</sub> and G<sub>2</sub> - in concentrations 200 and 30  $\mu\text{g}/\text{kg}$ , accordingly.

The identification of relatively high concentrations of aflatoxins in corn required a more detailed examination of granaries, and it was quite natural that a high degree of aflatoxin contamination was characteristic for granaries with inadequate regimens of storage. In such cases the relative indoor air humidity reached 80-83%, while the moisture content of affected grain fluctuated from 16 to 19% at a temperature of 19-25°C.

It should be noted that the presence of aflatoxins in rather high concentrations in several oblasts of Kazakhstan testifies to the necessity of a more strict control of storage conditions of grain products, and also to the elaboration of measures of grain decontamination and standardization of its further utilization. Having identified grain contaminants we presented concrete proposals to the Ministry

of Agriculture of the Kazakh SSR.

As a result of the above activity, due to the improvement of storage regimes, undertaken repairs, and notwithstanding long periods of storage, we failed to identify aflatoxins in corn harvested in 1982.

At present, the Centre collected the necessary documentation in the field of food contamination also by other contaminants found in Kazakhstan, in particular, nitrites, nitrates, n-nitrosoamines, heavy metals (including mercury and lead), several pesticides, etc.

The analysis of data on control systems allows to provide scientific motivation of the measures aimed at the reduction of food contamination and at the ensurance of complete safety of foodstuffs for human health.

One of the closest tasks of the Centre is the study of a real stress exerted by any food contaminant on man during a certain period of time (month, year) in various oblasts of Kazakhstan.

It should be said in conclusion, that the gained experience by the Centre on Control of Food Contamination by Foreign Agents proved the effect of the above forms of work, and that we can recommend these forms for the introduction in other Union Republics, and also in other countries.

Зак. 2126 ЦИК ВИННИТИ