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Short communication

EXAMINATION FOR CHEMICAL RESIDUES, RADIONUCLIDES AND GENETICALLY MODIFIED ORGANISMS IN GRAIN, FEEDSTUFFS AND FOODSTUFFS OF ANIMAL ORIGIN

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Food safety is becoming one of the most important health risk factors. The extensive use of chemicals in the agricultural sector as well as the changed lifestyles, cause health problems related to food in all countries around the world. Every country applies regulations and other measures in order to define the conditions and methods for internal and official control of food. This is done to improve food safety. More than fifteen thousand samples of food and feed have been tested to screen for pesticides, residues, histamine, mycotoxins, radionuclides, genetically modified organisms, nitrosamines and benzapyren in the frame of national monitoring programme. Samples of animal origin (red and poultry meat, dairy products, eggs, fish, seafood, honey), potatoes and other vegetables and grain and feedstuff were collected for this monitoring. The concentrations of chemical residues and radionuclides that were detected in the samples, are in agreement with the action levels reported in the national food safety standards.

Key words: monitoring program; heavy metals; mycotoxins; pesticides; histamine; genetically modified organisms; radionuclides; action level

ИСПИТУВАЊЕ НА ХЕМИСКИ ОСТАТОЦИ, РАДИОНУКЛЕИДИ И ГЕНЕТСКИ МОДИФИЦИРАНИ ОРГАНИЗМИ КАЈ ЖИТНИ РАСТЕНИЈА, СТОЧНА ХРАНА И ПРЕХРАНБЕНИ ПРОИЗВОДИ ОД ЖИВОТИНСКО ПОТЕКЛО

Безбедноста на храната станува еден од најважните фактори на ризик за здравјето. Зголемената употреба на хемикалии во земјоделскиот сектор, како и променетиот начин на живеење, предизвикуваат здравствени проблеми поврзани со храната во сите држави низ светот. Секоја држава применува регулативи и други мерки за да се дефинираат условите и методите за внатрешната и официјална контрола на храната. Ова се прави со цел да се подобри безбедноста на храната. Во рамките на националната програма за мониторинг се тестираа повеќе од петнаесет илјади примероци од храна и прехранбени производи за да се провери присуство на пестициди, резидуи, хистамин, микотоксини, радионуклеиди, генетски модифицирани организми, нитрозамини и бензапирен. За да се изврши овој мониторинг, беа собрани примероци од животинско потекло (црвено и пилешко месо, млечни производи, јајца, риба, морска храна, мед), компири и друг вид зеленчук, житни култури и сточна храна. Концентрацијата на хемиски остатоци и радионуклеиди кои беа забележани во примероците беше во согласност со ефективните нивоа наведени во стандардите за национална безбедност на храната.

Клучни зборови: мониторинг; тешки метали; микотоксини; пестициди; хистамин; генетски модифицирани организми; радионуклеиди; ефективно ниво

1. INTRODUCTION

Active anthropogenic activities result in significant changes of ecological situation. The extensive use, mainly in the agricultural sector, of such chemical preparations as veterinary medicines, plant protection products, chemical fertilizers, etc., causes the presence of these substances and their derivatives in final products. The general pollution of the environment contributes to the contamina-

tion of products in the process of production and market release, for instance it concerns dioxins and heavy metals (2). The number of pathologies directly or indirectly associated with the food quality is increasing. Therefore, consumer health protection is currently the priority task for both the EU countries and the RF that is reflected in the relevant legislation. In 2003 the RF Government laid down the procedure of the state monitoring based on the international standard ISO 9001:2000 aimed at the production of high quality products and services providing for laboratory tests of the established list of food products and feeds for a set of criteria confirming safety of the given product.

The results of analysis of the content of banned and harmful substances in foodstuffs and feedstuffs obtained during the annual monitoring are presented in the paper.

2. MATERIALS AND METHODS

The list of objects tested and criteria analyzed is presented in Table 1. Toxic elements (plumbum, arsenium, cadmium, mercury) in tested samples were detected by atomic absorption spectrometry using the spectrometer "GCM" (Austria). Mycotoxins, pesticides, histamines, benzapyren and nitrosamines were detected by highly efficient liquid chromatography ("Gilson", France). The content of radionuclides Sr-90 and Cs-137 was detected using the spectrometric complex "Progress" (OOO "NTTS Amplituda"). The presence of GMO was identified by PCR with cauliflower mosaic virus 35S promotor sequence and *Agrobacterium tumefaciens* NOS terminator as primer targets. The quantitative assessment for all the criteria was carried out in accordance with the Russian Federation standards.

Table 1

List of test objects and analyzed criteria

	Toxic agents	Radionuclides	GMO	Pesticides	Mycotoxins	Nitrosamines	Benzapyrene	Histamin
Meat	+	+	nt	nt	nt	nt	nt	nt
Variety meat	+	+	nt	+	nt	nt	nt	nt
Milk	+	+	nt	+	+	nt	nt	nt
Eggs	+	+	nt	nt	+	nt	nt	nt
Raw fish	+	+	nt	+	nt	nt	nt	+
Stock and salt fish	nt	+	nt		nt	+	+	nt
Sea food	+	+	nt	nt	nt	+	+	nt
Grain	+	nt	nt	nt	+	nt	nt	nt
Feedstuff	+	+	+	+	nt	nt	nt	nt
Honey	nt	+	nt	+	nt	nt	nt	nt
Potatoes	+	nt	nt	nt	nt	nt	nt	nt
Vegetables	+	nt	nt	+	nt	nt	nt	nt
Total	4746	5066	444	1334	1163	807	1163	720

+ tests were carried out, nt- not tested

3. RESULTS AND DISCUSSION

The results of the conducted tests are presented in Table 2.

None of the tested foodstuffs and feedstuffs contained toxic elements in the amount exceeding the action level that testified to the compliance of manufacturing process with the appropriate requirements.

The highest concentration of such toxic elements as plumbum, arsenium and cadmium was detected in cabbage leaves (30, 33 and 42% of action level, respectively) and formulated feeds (36, 39 and 27%, respectively). The use of such heavy metal primary accumulators as mineral ingredients and parts of vegetative plant organs is likely an additional factor of the increased content of these substances in feedstuffs (6). The concentration of heavy metals in potatoes was significantly lower

(10, 7.5 and 20% of action level, respectively), and tomatoes, cucumbers, egg-plants and sweet peppers turned out to be even less contaminated. But the content of mercury in these vegetables was more than in potatoes and cabbages in which the action level did not exceed 10%.

Table 2

Content of toxic elements in foodstuffs and feedstuffs, mg/kg

Foods and feeds	Plumbum		Arsenium		Cadmium		Hydrargyrum	
	Content	Action level	Content	Action level	Content	Action level	Content	Action level
Meat	0.06–0.1	0.5	0.012–0.036	0.1	0.001–0.004	0.05	0.003–0.008	0.03
Variety meat	0.05–0.09	0.6	0.10–0.35	1.0	0.03–0.07	0.3	0.05–0.15	0.1
Milk	0.008–0.015	0.1	0.06–0.012	0.05	0.001–0.003	0.03	0.002	0.005
Eggs	0.06–0.10	0.3	0.010–0.020	0.1	0.001–0.005	0.01	0.002–0.007	0.02
Raw fish	0.15–0.3	1.0	0.22–0.42	1.0	0.01–0.05	0.2	0.05–0.08	0.3
Sea food	3.2–4.4	10.0	1.0–2.0	5.0	0.12–0.28	2.0	0.012–0.032	0.2
Grain	0.10–0.16	0.5	0.01–0.07	0.2	0.001–0.003	0.01	0.001–0.009	0.03
Feedstuff	0.7–1.0	3.0	0.03–0.09	0.15	0.06–0.12	0.3	0.007–0.020	0.05
Honey	0.16–0.31	1.0	0.07–0.11	0.5	0.007–0.013	0.05	nt	
Potatoes	0.02–0.07	0.5	0.010–0.020	0.2	0.002–0.010	0.03	0.003–0.005	0.02
Tomatoes, eggplants, sweet pepper, cucumbers	0.01–0.06	0.5	0.005–0.05	0.2	0.004–0.015	0.03	0.01	0.02
Root crop	0.02–0.10	0.5	0.04–0.10	0.2	0.005–0.010	0.03	0.01	0.05
Cabbage	0.05–0.20	0.5	0.03–0.10	0.2	0.010–0.015	0.03	0.001–0.010	0.05

nt – not tested

The content of toxic elements in tested meat samples (pork, beef, poultry) was insignificant. Thus, the plumbum concentration was 0.06–0.11 mg/kg, arsenium 0.012-0.036 mg/kg, cadmium 0.001–0.004 mg/kg, mercury 0.003–0.008 mg/kg, that in generally corresponded to the results obtained by other investigators during the meat quality monitoring in the RF (3).

The content of plumbum, cadmium and mercury in by-products ranged between 18–24% of the action level.

The content of cadmium and mercury in milk products and eggs was approximately the same – up to 0.003 and 0.002 mg/kg, respectively. At the same time the content of plumbum in chicken eggs was 10 times, and arsenium – 2 times more than in milk products. However, the level of both heavy metals did not exceed the action level in any of the tested samples.

The concentration of plumbum, arsenium, cadmium and mercury in fish was 19, 31, 15 and 24%, respectively. The highest concentration of heavy metals (though it did not reach the action level that testified to the good ecological environment) was in shellfish and crustaceans which could accumulate toxic elements (4).

Organochlorine pesticides, mycotoxins and nitrosamines were not detected in the tested samples; this confirmed a low level of the given contaminants in the territory of the RF. According to official data the increased action level for these criteria in foodstuffs and feedstuffs is 2%.

The benzapyren concentration in processed shellfish, crustaceans and fish (smoked, cured, salted) was 0.00013–0.00028 mg/kg with the action level of 0.001 mg/kg that testified to the strict observance of technological standards during the production of these products.

The weight ratio of histamine in 80% of tested samples of frozen fish did not exceed 40 mg/kg though significant fluctuations of this value were observed in different fish species. For example, the histamine concentration in frozen herring and anchovy was 20–35 mg/kg, and in frozen

mackerel 40–55 mg/kg. In mackerel fillet this value was lower 35–40 mg/kg. This fact, probably, confirms the possibility of increase in histamine content during a long storage of frozen fish (5). It could be prevented by a quick evisceration of fish immediately after catching. The concentration of histamine in consignments of frozen fish of salmon species varied between 20 and 40 mg/kg. The highest concentration was observed in frozen tuna fillet (75 mg/kg) that correlated well with the data in literature (5), and the lowest (15–23 mg/kg) – in freshwater fish, especially in fresh carp. The histamine concentration did not exceed action level (100 mg/kg) in any of the consignments.

The content of radionuclides Sr-90 and Cs-137 in tested food and feed samples did not exceed the established action level.

444 samples of feed and feed additives were tested for the presence of genetically modified organisms, and 60 samples were tested positive. Most commonly these sources were detected in soya oil meal and protein, meat-meal, formulated feedstuffs for poultry, cattle and pigs. It should be noted that the use of genetically modified organisms for the production of feed is not prohibited by the Russian law. However these feedstuffs should be subjected to obligatory state registration.

4. CONCLUSION

Thus, the laboratory tests conducted under the state monitoring of residues of banned and harmful substances in live animals, products of animal and plant origin and in feedstuffs showed that the quality of all tested products complied with sanitary and hygiene requirements.

REFERENCES

Aronov E. L., Nino T. P., Surkov T. A., et al., *Food Safety in Russia and in Leading Countries of the World*. M. FGNU "Rosinformagrotech" (2005).

Barannikov A. D., Kirillov N. K., *Ecological Safety of Agricultural Products*. M. "Koloss" (2005).

Koltsov V. V., Evaluation of Meat and Meat Product Quality by Atomic Absorption Spectrometry. www.rusnauka.com.

Podgurskaya O. V., *Mytilidae* family Heavy Metal Detoxication Mechanisms; Author's summary of thesis by Candidate of Biological Sciences. Vladivostok. The Far East State University (2006).

Podsonnaya M. A., Rodina T. G., Histamine in Fish Products. *Food Technology*, 1, 30–32 (2004).

Toropova L. V., Arkhipov A. V., Makartsev N. G., et al., Practical Course in Animal Nutrition. Textbook for Higher Education Institutions. M. Koloss (2005).