Risk for Adolescent Health Due To Chemical Contamination of Food and Food Stock

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ABSTRACT
Based on the data on the volume of food consumption data according to the results of the actual nutrition study among the adolescents at the age of 15-17 they calculated the intake of chemical contaminants with local food products and food raw materials. They determined the main food products for adolescents, where chemical contaminants occur most frequently: fruits and vegetables, meat, grain, fish, drinks and milk. They determined the systems most susceptible to the total nonspecific effects at 95%: circulatory, cardiovascular, central nervous and reproductive systems. By the influence of imported products on functional systems they revealed circulatory system and the cardiovascular system. With combined intake of pollutants by food intake, the total hazard index for non-carcinogenic effect development by domestic products (HI) made 9.36 (95%), for imported products HI made 3.1 (95%).

Key words: chemical contaminants, regional exposure factors, adolescent health, non-carcinogenic risk, critical body systems.

INTRODUCTION
The problems associated with global food safety are an important healthcare issue. Within the framework of WHO, the Beijing Declaration on Food Safety adopted by the consensus of the International Forum on Food Safety "The Increase of Food Safety in the World Community" has determined the control over their safety as an essential public healthcare function that protects consumers against health risks created by biological, chemical and physical harmful factors associated with nutrition [1]. Food product safety measures should be based on current scientific evidence and ensure an adequate and an effective compliance with food safety legislation [2-6]. Chemical risk factors remain an important source of food related diseases. The evaluation should be based on internationally agreed principles and be conducted taking into account other factors, such as health benefits, socio-economic factors, ethical and environmental characteristics. As the means of food safety system improvement at the global level, it is necessary to use both positive and negative experiences of the countries with well-developed systems of such security. The diseases of food origin make a significant impact not only on health, but also on the development of many aspects of life. In particular, in the matters relating to the globalization of food trade and the development of international standards for these products promote the increase of awareness concerning the links between food safety and the export potential of developing countries. Therefore, nowadays the priority is the use of the method based on risk analysis, such as the system for risk analysis and critical control points and the development of the programs to monitor food and complete diet [1]. In the EU, product security is based on three key elements: legislation, operational response system and standards. In Russia, the priority is the state policy trend in the sphere of population provision with healthy and nutritious food. As the part of RF Government Decree (May 17, 2010) 376-r "The Doctrine of Food Security", "The Fundamentals of RF State Policy in the field of population healthy nutrition during the period until 2020" (The Order of RF Government (25.10.2010) No. 1873-r "On the approval of RF state policy foundations in the field of healthy nutrition of the population for the period until 2020") [7-10]. The wide spread of chemical pollutants in nature, their accumulation in plant and animal organisms directly from the environment or through so-called food chains condition chemical contamination of food raw materials, food products and the entry of xenobiotics (most dangerous to human health) into a human body with food through the gastrointestinal tract [11]. As was noted in several publications, the implementation of national nutrition projects should be carried out taking into account the regional characteristics of the population diet (1-3). The definition of the risk, associated with chemical contamination of food products for the health of a sensitive group of people, particularly the teenagers of Kazan, is relevant and will continue to be the basis for the development of further prevention measures.
Objective Of The Study
The purpose of the study was to assess the effect of food product chemical composition on the health of adolescents in the city of Kazan for the period of 2004-2016.

Material And Methods
The average daily intake of the main food groups by the teenagers of Kazan was determined via the method of 24-hour (daily) nutrition reproduction [12] recommended by the Federal State Scientific Research Institute "Nutrition Research Institute" for these purposes. The assessment of food safety for adolescents was carried out in respect of meat, fish, milk, eggs, bread and flour products, sugar, vegetable oil and other oils, fruits, vegetables and beverages. The list of the main contaminants under study included nitrates, heavy metals and pesticides. Exposure calculations, contribution of each of the product groups to total exposure value were carried out according to the formulas (1) and (2)

\[
Exp = \sum_{i=1}^{N} \left( \frac{C_i M_i}{BW} \right) \tag{1} 
\]

Where \( Exp \) is the value of pollutant exposure, mg/kg body weight/day (mg/kg body weight /week, mg/kg body weight); \( C_i \) is the pollutant content in the i-th product, mg/kg; \( M_i \) is the consumption of the i-th product, kg /day (kg /week, kg/year); \( BW \) is the human body weight, kg (standard value is 70 kg); \( N \) is the total amount of products included into the study.

The product contribution to the total value of pollutant exposure was calculated according to formula:

\[
C_a = \frac{C_k M_k}{\sum_{i=1}^{N} (C_i M_i)} \tag{2} 
\]

where \( Contr \) is the contribution of the k-th product to the total exposure value; \( C_i \) is the pollutant content in the i-th product, mg/kg; \( M_i \) is the consumption of the i-th product, kg/day (kg/week, kg/year).

Non-carcinogenic risk (route of ingestion: per os) is assessed by calculating the hazard quotient (HQ):

\[
HQ = \frac{I}{RfD}, 
\]

where \( I \) is an average daily dose substances by oral intake, mg/kg, \( RfD \) is a reference (safe) dose.

To assess the total effect of chemical substances, the total hazard index is used:

\[
HI = HQ1 + HQ2 + ... + HQn, 
\]

where \( HQq, HQ2, HQn \) are the hazard quotients of the 1st, 2nd ... n-th chemical substances. The calculation of HI is usually performed only for the substances, affecting the same body organs and systems.

In order to assess the risk and to calculate the probable dose of admission among the adolescents at the age of 15-17 years, they used the selective studies of diets. The performed assessment of non-carcinogenic risk has shown that the contamination of domestic food products is formed due to the effects of cadmium, mercury, lead, nitrates and nitrates. The systems most susceptible to total...
nonspecific effects are the circulatory system (HI 95%) - 3.3; cardiovascular system with the hazard index (HI 95%) of 1.65; central nervous system (HI 95%) - 0.74; reproductive system (HI 95%) - 0.74. According to the influence of imported products on functional systems, the following data were revealed: circulatory system (HI 95%) - 1.02; cardiovascular system (HI 95%) - 0.85. With the combined intake of pollutants by alimentary way, the total risk index for the development of non-carcinogenic effects by domestic products was 9.36 (95%), for imported products - 3.1 (95%) (Table 1).

Table 1. Critical organs and systems based on non-carcinogenic risk evaluation results during the receipt of chemicals with domestic and imported food products.

<table>
<thead>
<tr>
<th>Critical organs and systems</th>
<th>Domestic products</th>
<th>Imported products</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Me (%)</td>
<td>95 %</td>
</tr>
<tr>
<td>Blood</td>
<td>1.04</td>
<td>3.3</td>
</tr>
<tr>
<td>Kidneys</td>
<td>0.10</td>
<td>0.58</td>
</tr>
<tr>
<td>Hormones</td>
<td>0.10</td>
<td>0.58</td>
</tr>
<tr>
<td>Skin</td>
<td>0.02</td>
<td>-</td>
</tr>
<tr>
<td>CNS</td>
<td>0.19</td>
<td>0.74</td>
</tr>
<tr>
<td>NS</td>
<td>0.14</td>
<td>0.5</td>
</tr>
<tr>
<td>CVS</td>
<td>0.41</td>
<td>1.65</td>
</tr>
<tr>
<td>Immune system</td>
<td>0.04</td>
<td>0.23</td>
</tr>
<tr>
<td>Reproductive system</td>
<td>0.19</td>
<td>0.74</td>
</tr>
<tr>
<td>Development</td>
<td>0.14</td>
<td>0.5</td>
</tr>
<tr>
<td>Biochemistry</td>
<td>0.14</td>
<td>0.5</td>
</tr>
<tr>
<td>Cancer</td>
<td>-</td>
<td>0.001</td>
</tr>
<tr>
<td>HI</td>
<td>2.55</td>
<td>9.36</td>
</tr>
</tbody>
</table>

During the evaluation of the non-carcinogenic risk, they revealed the percentage of each contaminant consumed with food. A significant contribution is made by 41.95% (Me) and 29.4% (95%) nitrates, as well as nitrates - 35.7% (Me) and 42.4% (95%). The following results were obtained for the products of the imported production: the leading ones are the nitrates with the values of 75.4% at the median level and 74% (95%), lead - 17% (Me) and 14.3% (95%). The main substances developing the total hazard index were cadmium, lead and mercury. The first place was occupied by lead, the share of which was 12.6% (Me) and 12.9% (95%), the second position was occupied by cadmium 5.54% (Me) and 9.04% (95%) and mercury - 3.92 (Me) and 6.11 (95%), respectively (Table 2).

Table 2. The share of each contaminant in food from the total hazard index (HI).

<table>
<thead>
<tr>
<th>Contaminants</th>
<th>Domestic products</th>
<th>Imported products</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Me (%)</td>
<td>95 (%)</td>
</tr>
<tr>
<td>Cadmium</td>
<td>5.54</td>
<td>9.04</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.16</td>
<td>-</td>
</tr>
<tr>
<td>Mercury</td>
<td>3.92</td>
<td>6.11</td>
</tr>
<tr>
<td>Lead</td>
<td>12.67</td>
<td>12.92</td>
</tr>
<tr>
<td>Nitrites</td>
<td>41.95</td>
<td>29.47</td>
</tr>
<tr>
<td>Nitrates</td>
<td>35.73</td>
<td>42.41</td>
</tr>
<tr>
<td>Benzapyrene</td>
<td>-</td>
<td>0.02</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Conclusion
When lead enters a body, the abnormalities of reproductive processes, the central nervous system activity, gastrointestinal tract, cardiovascular and excretory system may take place, the formation of kidney adenoma and adenocarcinoma can occur
Acknowledgments
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