

Prevention of Occupational Diseases When Working with Chlorine, Fluorine and Alkaline Metals

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Abstract

This paper presents a food product intended for the prevention of occupational diseases when working with chlorine, fluorine and alkali metals. The effectiveness of the proposed food product lies in the ability to inhibit the accumulation of harmful chemicals in the body and reduce the risk of occupational diseases in a work environment. The product includes ingredients with a preventive effect that can accelerate the elimination of toxic compounds of chlorine, fluorine and alkali metals from the body.

The intake of inorganic compounds is carried out mainly through the gastrointestinal tract and respiratory system. In this case, their absorption through the mucous membranes of the upper respiratory tract and circulation in combination with serum albumin is observed. The development of acute and chronic intoxication (occupational fluorosis) is possible when fluoride and its inorganic compounds act on the body.

Chlorine compounds lead to irritation of the interoreceptors of the mucous membranes of the upper respiratory tract, cause spastic effects in the bronchi, alter the heart rhythm and function of the vascular centers.

Keywords

Occupational Diseases, Fluorine Intoxication, Chlorine Intoxication, Alkali Metal Intoxication, Cereal Product, Therapeutic Nutrition, Labor Protection.

Introduction

The resorptive and irritating effect of fluorides is explained by the formation of toxic fluorine ion in the body. Fluorides precipitate calcium from cellular protoplasm in the form of calcium fluoride insoluble in tissue fluids. Such an action of fluorides inevitably leads to a violation of neuromuscular excitability, increased vascular permeability, and a change in enzymatic processes. Significant in the pathogenesis of fluoride intoxication is its interaction with Mg, J, Fe, Zn, which leads to metabolic disorders. Of great importance in the mechanism of intoxication is given to impaired liver function. When fluoride enters the body, it begins to irritate the eyes and upper respiratory tract (especially with the inhalation effect of hydrogen fluoride and elemental fluoride). Complaints of workers are characterized by sensations of pain and burning, dry nose and throat, nosebleeds, hoarseness, loss of voice, dry cough, and chest tightness. With severe intoxication phenomena, body temperature rises to 39–40 ° C, a “barking” cough intensifies, suffocation appears, associated with reflex respiratory disorders and spasm of the larynx and bronchi. Acute rhinitis, laryngitis, tracheitis, bronchitis, sometimes purulent, bronchiolitis develop, toxic pulmonary edema is possible. With fluoride intoxication, eye and eyelid skin damage is possible. The most typical clinical picture of the chronic effects of fluoride compounds is fluorosis - a kind of bone changes such as osteoporosis or osteosclerosis associated with a violation of calcium metabolism. [1,2,3]

In case of chlorine poisoning, the first symptoms are burning and sharp pain in the eyes, lacrimation, photophobia, conjunctival redness, runny nose, feeling of scratching in the throat, dry cough, chest pain, and asthmatic bronchitis is possible. In more severe forms of poisoning, headache, dizziness, weakness, nausea, vomiting, sharp agitation and fainting are noted. Clinical symptoms are characterized by an increase in changes in the cardiovascular system: tachycardia, hypotension, cardiac weakness. Dyspeptic disorders are possible. In the future, a worsening of the condition may be noted, accompanied by loss of consciousness, oppression of reflexes, narrowing of the pupils, cyanosis, impaired cardiac and respiratory activity, convulsions, coma. [4]

Sometimes after coming out of a coma, the clinical picture of pulmonary edema is noted.

One of the ways to protect the health of workers is preventive nutrition, which includes, in addition to the actual food, various vitamin supplements. It is provided free of charge according to federal regulations. The main goal is to reduce the harmful effects on the body of hazardous working conditions. It is achieved by selecting the appropriate nutritional scheme for employees. The normative regulation of the Labor legislation of Russia guarantees the free provision of special therapeutic and preventive nutrition.

Medical and preventive nutrition is provided at work with particularly harmful working conditions, free of charge according to established standards. People employed full-time (shift) at the factory are given therapeutic and prophylactic nutrition and for days of disability due to occupational disease, if the patient is not hospitalized. The delivery of therapeutic and preventive nutrition is carried out in the form of hot breakfasts before the start of the working day and, in cases provided for by law, lunch in the middle of the working day. [5,6,7]

Special medical and preventive nutrition is a comprehensive measure aimed at improving comfort and protecting the interests of employees exposed to increased risks and loads. To ensure this rule of law, the employer must have a dining room in which food will be prepared, as well as people will be able to eat food before and in the middle of the working day. [8]

Employees entitled to receive treatment and preventive nutrition are entitled to the constant influence of one or a complex of harmful factors (about 1000 items): chemical (toxic organic or inorganic substances, their compounds); biological (dangerous strains of microorganisms, cells and spores); physical (ionizing radiation).

To protect the health of people working in hazardous industries, special diets have been developed. Products and vitamin supplements for them are combined taking into account harmful production factors. The use of each of the components in a particular nutritional scheme is determined by its special properties. For example, cottage cheese, ascorbic acid have activity against silicosis - a frequent occupational disease among miners. Pectin, which is rich in many fruits and vegetables, is able to bind heavy metals, removing them from the body. But the consumption of excessively salty, rich in refractory animal fats food should be reduced in favor of more easily digestible dishes, since fats enhance the absorption of toxic substances in the digestive tract, and salt slows down their excretion.

Eight rations rationally fixed for various harmful industries. The combination of components in each of them is individual, since it depends on the influence of any negative factors on the body that needs to be minimized. One such example is diet No. 2, which is intended for workers in the production of sulfuric, nitric and other acids, cyanides, in contact with formalin, alkali metals, chloride or fluoride compounds. The main goal in this case is to prevent intoxication of the body and the elimination of toxins due to specially selected nutrition, dairy products and cereals. [9,10,11,12]

Materials and Methods

As objects of study, production conditions were considered under which there is a risk of poisoning by chlorine, fluorine and alkali metals. In many sectors of modern industry, such as chemical, textile, pharmaceutical, chlorine and its compounds are actively used, namely:

- in the production of solvents, substitutes for leather, plastics, rubbers, plastic compounds, polyvinyl chloride (with the help of these materials linoleum, textiles, shoes, insulation for wires are made);
- in the pulp and paper and textile industries, chlorine is used as a bleaching agent for paper and fabrics;
- in the agricultural industry, chlorine is used in the fight against insects - pests in crops using organochlorine insecticides;
- for disinfection (chlorination) of water in the pipeline, water in pools, as well as for sterilization of wastewater;
- It is used in the manufacture of disinfectants, pharmaceuticals, bleach, synthetic hydrogen chloride, pesticides, hydrochloric acid, metal chlorides, chlorates, hypochlorites;
- in metallurgy it is used in the preparation and refining of many metals, and in non-ferrous metallurgy it is used for the chlorination of ores in order to extract certain metals (titanium, niobium, zirconium).

It should be noted that chlorine is a chemically hazardous substance with toxic properties.

There are four degrees of chlorine poisoning:

Mild - signs: irritation of the mucous membranes of the mouth and respiratory tract; obsessive smell of chlorine when inhaling clean air; cough; lacrimation. These signs are not symptoms for first aid and treatment, as they disappear after a few hours.

The average degree - symptoms: shortness of breath, sometimes leading to suffocation; lacrimation chest pains. With these symptoms, timely outpatient treatment is necessary, otherwise pulmonary edema may occur after 2–5 hours.

Severe - symptoms: sudden holding or stopping breathing; loss of consciousness; convulsive muscle contractions. To neutralize the severe degree of chlorine poisoning, it is necessary to urgently begin resuscitation, including mechanical ventilation. The consequences of such exposure to chlorine can lead to damage to body systems and even death within half an hour.

Lightning (rapid) poisoning - the symptoms appear in the form of convulsions, swollen veins in the neck, loss of consciousness and respiratory failure, which lead to death. Treatment with this degree of administration of chlorine is almost impossible.

Another pollutant in the air of the working area and atmosphere is fluorine contained in emissions from the production of plastics, fertilizers, aviation gasoline, insectofungicides and organofluorine compounds. Fluoride is a neurotoxin that accumulates in tissues and bones, causing neurodevelopment similar to Alzheimer's syndrome. Fluoride poisoning manifests itself in colds, chronic fatigue, muscle weakness, and the inability to restore strength after rest.

In addition, fluorine enhances the influence of toxic substances (lead, arsenic, pesticides), inhibits key enzymes, weakens the immune system. There are 3 stages of fluorine poisoning (N.A. Bogdanov, E.V. Gembitsky).

The first (mild) - functional disorders of the nervous and cardiovascular systems, damage to the upper respiratory tract, bronchi. At this stage, the initial signs of destruction of bone tissue, most often manifested in the bones of the pelvis and femurs, can also be noted.

The second (moderate) is a symptom complex of chronic intoxication in the form of gingivitis, stomatitis, bronchitis, asthenic conditions, thyroid dysfunction, neurocirculatory dystonia, chronic gastritis, hepatitis. More distinct and "specific" for this stage, bone disorders are manifested by periosteal growths and thickening of the bone beams and narrowing of the medullary canal of long tubular bones, destruction of bone tissue in the spine.

The third (severe, rare) - intoxication in the form of widespread osteosclerosis, joint stiffness, developing against a background of protracted asthenic conditions, pronounced pulmonary and cardiovascular pathology. At this stage, the disease tends to progress.

Other industrial pollutants are alkali metals: lithium, sodium, potassium, rubidium, cesium and radioactive France. Currently, all alkali metals are highly active in the interaction with water, oxygen, halogens and other compounds. Interactions with water are especially dangerous, since the reaction products are caustic alkalis, and there is also a huge release of energy, accompanied by a fiery flash (in the case of potassium) or an explosion (in the case of rubidium or cesium). The ingress of alkali metals into the human body is possible during their burning, cutting and cleaning of ingots, mechanical cleaning of equipment, dry cleaning, as a result of spraying of burning metals in a fire, etc.

The most severe defeat in the workplace is the ingestion of alkalis into the body through the digestive tract. The victim develops pain along the gastrointestinal tract, there is vomiting with impurities of blood, discomfort in the abdomen, turning into severe colic. In addition, there is a cough, increased salivation, shortness of breath, cramps, continuing until loss of consciousness and a marked decrease in blood pressure. Vapors can affect the skin, eyes and mucous membranes of the respiratory tract. In case of vapor poisoning, the very first symptom is the occurrence of pain during breathing, an uncontrollable cough, sneezing, conjunctivitis and hyperemia of the skin. Alkali metals cause bronchospasm, which can lead to suffocation. As a preventive measure, it is useful to use milk for the protein neutralization of non-absorbed substances. If vapors enter the upper respiratory tract, rinsing the mouth and nose with citric acid helps. If possible, do oil inhalation. [13,14]

Results

According to order No. 46n of the Ministry of Health and Social Development of the Russian Federation of February 16, 2009 (Appendix No. 2, registered with the Ministry of Justice on April 20, 2009, No. 13796), the Institute of Nutrition RAMS proposed a therapeutic and preventive diet No. 2, alkaline, as it includes polyunsaturated fatty acids, high-grade proteins, biologically active components that inhibit the accumulation of dangerous chemical compounds in the body. This diet is intended for individuals working with fluorine compounds, alkali metals, chlorine, cyanide compounds in the production of sulfuric and nitric acid.

The authors of the article developed a food product for the nutrition of workers with fluorine compounds, alkali metals and chlorine, received a RF patent No. 2 685 900 (published on 04/23/2019, bull. No. 12). Table 1 shows the ingredient composition and energy values of this product.

The proposed food product includes proteins of high biological value, dietary fiber, vitamins, as well as prophylactic components of food, which, when combined, leads to the binding and effective removal of harmful chemical compounds of fluorine, alkali metals and chlorine from the body.

The process of preparing a cereal bar consists in preparing a mixture of oat bran, wheat fiber, brown rice flour and millet, flaxseed, chopped laminaria, dried parsley and sassaparilla. Then add chopped lettuce and garlic. Next, prepare fruit and vegetable puree from fresh apples and carrots with the addition of caraway seeds, chopped ginger root, asparagus and chopped turmeric root. After that, all dry and liquid components are thoroughly mixed. The resulting mass is distributed in a baking dish, kept for 15-20 minutes and baked in an oven at a temperature of 180 degrees for 10-12 minutes. After that, the obtained cereal cake is cooled and cut into bars weighing 30 g.

Ingredients	Weight, g	Content, g			Energy value, kcal
		Proteins	Fats	Carbohydrates	
oat bran	70	12,11	4,9	46,34	172,2
large wheat fiber	50	8	11,75	1,9	93,2
brown rice flour	60	4,44	1,08	43,7	202,2
fresh lettuce	25	0,35	0	0,73	3,75
dried brown kelp	155	1,40	0,31	0,93	38,68
dried parsley	70	2,1	0,56	4,2	25,2
freshly chopped carrots	60	0,54	0,12	6	24,6
millet flour	70	8,05	2,31	46,55	239,4
freshly chopped apples	40	0,12	0,08	5,52	20,8
caraway	30	8	6	20	99,9
ginger	50	0,9	0,4	9	40
garlic	30	1,8	0,15	9,9	44,7
asparagus	50	2,2	0,1	3,9	20
sassaparil	100	0,05	0	0	0,05
flaxseed	55	10,1	23,2	15,8	293,7
linseed oil	50	0,05	50	0	442
turmeric root	35	2,8	3,5	22,75	123,9
TOTAL	1000	63,01	106,45	254,95	1940,65
Total	30	1,89	3,2	7,65	58,22

Table 1: The Composition of the Cereal Product for the Prevention of Occupational Diseases when Working with Chlorine, Fluorine and Alkali Metals

Conclusion

Thus, the composition of this product includes plant-derived ingredients necessary for the human body, dietary and fruit fibers, as well as vitamins of groups B, E, K, PP and C, which have an alkaline and preventive effect and accelerate the elimination of harmful chemicals from the body. A cereal bar can be an equivalent product in therapeutic and prophylactic nutrition, as well as an additional source of food components with a high content of useful components, which will provide a lack of energy value in the nutrition of individuals when working with fluorine compounds, alkali metals and chlorine. [15,16]

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