

# CHEMICAL SCIENCES

## EXPRESS METHOD OF ANALYTICAL CONTROL OF WATER-SOLUBLE FLUORIDES IN SOILS AND GRAINS

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**Introduction.** The urgency of the problem of food safety is growing every year, since the provision of quality food is one of the main factors that determines the health and preservation of the gene pool. Qualitative can be considered products that do not cause danger, adverse impact on the health of present and future generations.

One of the most significant reasons that threaten human health is the problem of xenobiotic that content in products. In order to ensure food security, special attention must be paid to monitoring the contamination of soil and plant materials. There are several territorial biogeochemical provinces in Ukraine. Biogeochemical provinces include the Poltava region with certain areas. Poltavas region is a fertile land with grain crops. There is a steady tendency towards deterioration of the quality of soils, most of which are allocated for agricultural land. Furthermore, they are characterized by an increased content of fluorine forms. It has been proven that it is the mobile water-soluble forms (alkali metal fluorides) that pose a particular danger, since they are passively and easily transferred in plants. The absorption of fluorides by plants leads to impaired respiratory activity and a decrease in oxygen absorption; a decrease in chlorophyll content and a decrease in the assimilation of nutrients (including starch); oppression of the functions of some enzymes and catalysts; damage to cell membranes; changes in the metabolism of cell organelles and

destruction of nucleic acids; synthesis of a toxic compound of fluorine - fluoroacetate.

The result of the above described processes is a general slowdown in plant growth and a decrease in their yield. But the biggest danger of fluoride contamination of plants is that they are a source of possible fluoride intake into the body of animals and humans. The toxicity of fluoride on the human body has been well studied. The stable form of the existence of this element in the body is the fluoride anion. The toxicity of fluoride anion is primarily due to the formation of poorly soluble salts (fluorides) and complex compounds with cations and other biogenic elements - activators of enzyme systems. As a result, many enzymes is suppressed, the metabolism of carbohydrates and fats is disrupted, and the oxidation of fatty acids is inhibited. Secondly, fluorides have greater chemical activity than iodides, and therefore can be their competitors in the synthesis of thyroid hormones, and accordingly, affect its functions, causing diseases. In addition, fluorides are unevenly distributed in various tissues of the human body, having an affinity for calcified tissues, they accumulate in them throughout life. Prolonged excessive intake of fluorides into the body can cause a pathological condition - fluorosis (the appearance of a specific color of tooth enamel), and violations of bone mineralization (there is a compaction of the pelvic bones, spine, ribs, restriction of chest mobility). The hematopoietic organs also experience the negative influence of the action of high concentrations of fluorides, since the red sprout of the bone marrow is irritated and the white brain is inhibited.

**Aim.** In this regard, the purpose of our research is to determine by the express method the levels of accumulation of this element in grain crops, which are most often grown in the Poltava region and are of strategic importance for Ukraine.

**Materials and methods.** In Ukraine, fluorides in raw materials and products, are not regulated by regulatory documents. The object of the study of the accumulation of water-soluble fluorides in raw materials was the main grain crops of the Poltava region: wheat, corn, soybeans and sunflower. Soil samples and plant raw materials were used in areas with high fluoride content in water. The studied soils are

predominantly chernozems. Sampling for fluoride analysis was carried out in accordance with the current state standard 17.4.4.02-84 and state standard 3355-96. Chemical and analytical studies were carried out at the bases of the State Enterprise "Poltavastandmetrologiya" and at the Department of Medical Chemistry of the Ukrainian Medical Dental Academy (UMDA).

A potentiometric method was used to quantitatively determine the content of gross and water-soluble fluorine in soils and plants.

To determine the total fluorine in the soil, the samples were first fused; water-soluble fluorine was obtained by extraction. To determine fluorides in plants, the samples were first subjected to ash.

**Results and discussion.** The maximum permissible amount in the soil of all forms of fluorine is not regulated by regulatory documents, but according to some sources it is within 330 mg / kg, and for water-soluble forms it should not exceed 10 mg / kg.

As test methods for the determination of fluorides in water, soils and plant materials, we have proposed an indicator system lanthanum-eosin, which is based on a change in the color of test strips connected with the presence of fluorides. The lanthanum-eosin complex in acidic solutions has an orange-pink color; when fluorides are presented - it changes to brown. The determination was carried out at pH 1-3. The detectable minimum of fluorides is 0.02 mg/l, the detection limit is 100 mg/l.

According to the results of soil research, an excess of the content of water-soluble fluorides is observed in all studied territories. The greatest excess of the amount of fluorides is observed in some regions: the excess is 3 and 4 times. As a result, the vast majority of crops growing on these soils with high fluoride content. Thus, the content of fluorides in corn grain exceeds the norm by 4-5 times, in barley - 3 times, in sugar beet - 7 times, in soy - 4.5 times. It is clear that by consuming the products made of these plants, the daily intake of fluoride in the human body will exceed the daily requirement (1.5-4 mg).

The main danger arising from the consumption of plants, contaminated with fluorides, is that they convert inorganic fluoride compounds, absorbed from soil or air into organic ones, which are much more toxic to humans. So, according to the data, organic fluorine compounds extracted from soybeans are 500 times more toxic than their inorganic compounds.

**Conclusions.** The analysis of literary sources and own research on the causes of a number of human diseases on the territory of the biogeochemical province was carried out; the effect of excess fluorides on the human body was presented; the results of monitoring pathologies caused by an excess of fluorides in water and plant foods in the Poltava region in recent years is determined. Possible ways of solving the problem of fluoride pollution of soils, waters and agricultural plants of the geochemical province are given. The results of the development of modern methods of analytical express control of fluorine make it possible to monitor the state of soils, water and plant raw materials not only in the conditions of geochemical provinces, but also in areas characterized by an increased content of this element, as a result of anthropogenic human activity.