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# ANALYSIS OF MACRO AND MICROELEMENTS IN TEETH, SALIVA, AND BLOOD OF WORKERS IN FERGANA CHEMICAL PLANT OF FURAN COMPOUNDS

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## ABSTRACT

This article aims to share the results of research conducted in the Fergana chemical plant of furan compounds (FCPFC) in Uzbekistan.19 workers of the Furan compounds plant, in Fergana, Uzbekistan, were tested. By neutron activation analysis method, we have studied microelement composition of saliva, blood, dental hard tissue, and the level of Ca, Zn, Fe, and Ag in these subjects. We have detected that the level of chemical elements in dental hard tissue, blood, and saliva of these workers was subject to negative changes as compared to the analysis results from those in the control group.

The research results have practical value for the prophylaxis, treatment, and health resumption of the people living in rugged ecological environment and workers who are engaged with harmful substances in chemical industry. Furthermore,this research also provides recommendations for treatment of dental diseases related to common conditions of pathophysiological processes carried out by living organisms.

## UDC CODE & KEYWORDS

■ UDC: 616.314, 612.014.46 ■ Furan compounds ■ Dental ■ Saliva ■ Blood ■ Microelements ■ Mineralization ■ Hard tissue

## INTRODUCTION

The notion of biological role of chemical elements is wide enough and includes various appearances. The existence of chemical elements in living organisms can be considered as the most fundamental characteristic of their biological role (Agadjanyan, Veldanova, & Skalniy. 2001, p. 236; Notova, Ordjonikidze & Nigmatulina. 2003; Oberlis, Harland, & Skalniy. 2008, p. 544).

Elemental composition analysis of certain types of organisms permit us to discuss about phylogenetic and ontogenetic aspects, as well as the elemental composition analysis of different external influences on the entire organism (Agzamkhodjayev, Baybekova, Bekmetov & Gafforov, 2004; Verbovoy & Zeytlin, 2000). Furthermore, we have tried to shed some light on anatomical systemic condition under extreme conditions by revealing the process of specific elements accumulation and by analyzing elemental composition of an organism through toxicological properties, etc.

In this research, working environment in chemical plants is considered to be extremely hazardous (Gulyayeva, 2004, p. 107; Michos, Kalfakakou, Karkabounas, Kiortsis & Evangelou. 1990). We analyzed the main biologically active elemental contents in teeth, saliva, and blood of workers at Fergana chemical plant of furan compounds (FCPFC).

### Materials and research methodology

With the help of complex modern instrumental methods of neutron activation analysis, it was possible to detect chemical composition of such elements as Ca, Zn, Fe, and Ag in blood, mixed unstimulated saliva, and dental hard tissue from 19 workers at FCPFC. In addition, we also analyzed samples obtained from Fergana city people, as our control group.

The mass of mixed unstimulated saliva (gathered within 20 minutes) was 5.8+0.2 mg/sm$^2$, and its formation rate was equal to 0.5+0.1 milliliter per minute.

Extracted dental plaque and deposits were carefully gathered, rinsed in distilled water, and dried in thermostat at 150-160°C before being cooled. Then, enamel, dentin, and tooth cement were separated and thoroughly powdered in an agate mortar – sample weighed between 20-70 milligrams.

Metering was conducted in germanium detector and spectrophotometric detector connected to a computer. The following standards were used for element typing: laboratory, Nuclear Physics Institute of Academy of Sciences of the Republic Uzbekistan (through coating known amount of one or another determinant element on dehydrated filter paper), and IAEA's standard comparison samples N-4 and NN-4 and comparator method. Biochemical analysis of the saliva sample was conducted by using common modern techniques.

### Results and discussion

Research results showed that the zinc (Zn) and iron (Fe) concentration in blood of FCPFC's workers is reduced by 1.4 times on average (Table 1).

All functional diversities of Zn and Fe, and their significance in carbohydrate, phosphoric, and protein metabolism are determined through their presence in most enzyme systems. In formation of bone tissue, the presence of alkaline phosphatase, in the active center of which there is Zn, is determined. For normal course of proline and lysine hydroxylation reaction, iron in flow is essential in procollagen. According to Hodson (Hodson, Bush, Geddes. 2007), zinc is essential for supporting optimal concentration of Vitamin A in plasma; under normal conditions, this microelement determines Vitamin A mobilization from the liver. Finally, zinc has an effect on supplementary system function. Therefore, we deem that lack

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of Zn and Fe in chemical industry workers' will have negative impacts on their dental hard tissues development and deteriorate their general condition and resistance to caries.

Table 1: Elements content: Ca, Zn, Fe, Ag in teeth, saliva, blood of workers at FCPFC

| Object of analysis | Elements | People who do not have any connection with chemical compounds (control group) | FCPFC's workers |
|---|---|---|---|
| **Blood** | $Ca^{+2}$mg/da | 10.9+0.71 | 11.2+0.51 |
| | Zn | 112.0+12.0 | 76.4+4.52 |
| | Fe | 124.0+6.4 | 96.0+4.1 |
| | Ag | 0.24+0.01 | 0.20+0.01 |
| **Saliva** | $Ca^{+2}$ mg/da | 8.11+0.24 | 7.72+0.61 |
| | Zn | 30.8+1.46 | 74.6+3.78 |
| | Fe | 88.4+3.1 | 62.1+2.78 |
| | Ag | 0.08+0.001 | 0.06+0.001 |
| **Enamel** | $Ca^{+2}$ | 26.4+1.88 | 30.8+1.36 |
| | Zn | 198.6+11.4 | 3763.0+131.0 |
| | Fe | 58.6+1.4 | 63.1+0.86 |
| | Ag | 1.33+0.01 | 1.45+0.02 |
| **Dentin** | $Ca^{+2}$ | 36.0+1.4 | 29.8+1.4 |
| | Zn | 324.0+14.1 | 3881.0+1440 |
| | Fe | 0 | 0 |
| | Ag | 0.41+0.01 | 0 |
| **Dental cement** | $Ca^{+2}$ | 26.0+0.91 | 24.8+0.84 |
| | Zn | 852.0+19.8 | 3036.2+131.4 |
| | Fe | 68.4+2.4 | 471.8+42.1 |
| | Ag | 0.25+0.01 | 1.24+0.23 |

Source: Authors

Mineralizing is one of the main functions of salivary glands. This mineralizing function basically consists of mechanisms that prevent the outlet of constituent components from enamel and assists the flow of such components from saliva to enamel. Namely, these mechanisms provide dynamic equilibrium condition to enamel composition and its circumoral biological fluid – saliva.

We have analyzed microelement contents in mixed saliva with the help of neutron activation analysis, and we can conclude from the research results that zinc content in saliva ($P<0.05$) is higher than any other research elements (Ca and Ag), which were within the scope of reference quantity. In addition, iron content in blood is reduced. If we take into account that saliva participates in teeth mineralization process and provides dynamic equilibrium condition to enamel's composition, then it is natural that observed Zn dynamics in saliva is directed to ward an equilibrium between saliva and dental hard tissue.

Mineral composition analysis results of calcium (Ca), zinc (Zn), iron (Fe), and silver (Ag) contents in enamel surface layer are given in Table 1. According to the analysis data of the workers at furan compounds plant, enamel calcium content increased in significantly; zinc content is 18 times higher and iron content is in 9% higher.

According to the data obtained, dental deposit impacts the dynamics of enamel mineral composition detected during the research as there are not only Ca and P, but also proteose-collagenase, and hyaluronidase. Moreover, there are proteins, glycoprotein, enzymes, and polysaccharide of microbial origin in dental deposit as well. Namely,a high level of microbial enzymes in zinc active ion center determines the increase of the latter in enamel.

Increased zinc content in saliva causes its high flux not only into enamel, but also into dentin. However, the amount of calcium content in dental hard tissue does not change.

As we can see in Table 1, zinc ion concentration in dentin of the workers at FCPFC is 15 times. If to take into account that collagenosis and DNA-RNA polymerase are required for constructing dentin's main substance, then observed zinc ion dynamics becomes evident. The Aforementioned indicates that remineralization (dentin formation) process in workers of FCPFC is accelerated. But, it is not known whether the mineral basis of dentin, hydroxyapatite crystals, is sufficient.

Similar dynamics of microelements content is recorded in cement. Interestingly, the level of iron (Fe) and silver (Ag) surpasses reference quantity by seven times. If we take into account the fact that primary cement consists of collagen fiber, then the high level zinc ion becomes evident. On one hand, high level of Fe and Ag, in cement, is apparently determined by hypercementosis; on the other hand, it is determined by various concomitant diseases in workers at the furan compounds plant. This again confirms the participation of dental hard tissues in general metabolism.

On one hand, observed changes in microelement structure of the blood, saliva, and dental hard tissues in workers at furan compounds plant are conditioned by microbial origin dental deposit;on the other hand, they are conditioned by the acceleration of dentin formation process and hypercementosis. Saliva also ply as an important role in the aforementioned processes. Saliva as a natural fluid in a biological environment is very important for dental activity, particularly in maintaining dental tissue homeostasis in oral cavity.

Saliva consists of such enzymes as acid and alkaline phosphatase, ALT, AST, etc.

A research was also conducted to determine the influence of chemical industry factors on phosphatase and transaminase activity in saliva. The results of conducted research showed that people who work at FCPFC have high acid phosphatase activity, which is apparently conditioned by lysosomal membrane destabilization and by a shift in the saliva pH toward acidic. Alkaline phosphatase activity decline maybe related to saliva acidification (Table 2).

Table 2: Phosphatases, transaminases activity and crude protein content in the saliva of workers at FCPFC

| Test group | Number of people tested | Activity in ml mole per liter | | | | Crude protein content (mg/dl) |
|---|---|---|---|---|---|---|
| | | Acid phosphatases | Alkaline phosphatases | Aspartate transaminases | Alanine transaminases | |
| **Control group** | 20 | 21.2+1.4 | 9.1+0.88 | 14.6+0.81 | 12.8+0.78 | 252.0+14.6 |
| **Workers of FCPFC** | 21 | 26.8+1.2 | 7.2+0.54 | 26.2+1.3 | 17.8+0.91 | 259.0+11.4 |

Source: Authors

In chemical industry workers who have direct contact with noxious agents, there were observed growth activity of alanine and as partate aminotransferase. Perhaps, it is because of compromised liver function.

Based on the analysis results presented, we can conclude that the change in saliva enzymatic spectrum, of chemical industry workers, are conditioned by an impact of noxious agents. Essential buffer systems, especially phosphate, carbonate and protein systems are vital in supporting saliva homeostasis.

## Conclusion

Changes observed in microelement contents in blood, saliva, and tooth hard tissues of the workers at the furan compounds plant are conditioned by two factors – dental deposit of microbial origin and acceleration of dentin formation process and hypercementosis.

Conducted research also showed that in,chemical industry's workers who have direct contact with noxious agents, there was an increase in cytolytic activity, which is related a compromised liver function.

The problems encountered during the inquiry influenced and inspired us in planning for better medical and sanitary conditions in industrial setting, and providing proper care of their health.

Medical examination and monitoring of worker's oral cavity, partially, tooth and saliva must be conducted every quarter in order to prevent irreversible damages to the workers in chemical industry, as they are subject to potentially harmful elements leading to accelerated dental health deterioration.

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