Research Article

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# Determination Content of *Zn, Cd, Pb, Cu* In Canned Cucumbers, Lemon Juices and Tea Drinks Produced in The Republic of Azerbaijan

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## SUMMARY

This article highlights the results of analyzes of the content of *Zn, Cd, Pb, Cu* in vegetable raw materials grown on the territory of the Republic of Azerbaijan and their processed products. Mass concentrations of *Zn, Cd, Pb* and *Cu* were measured by stripping voltammetry after preliminary preparation of samples by "wet" mineralization. The stripping voltammetry method is based on the ability of the elements accumulated on the working electrode from the analyzed solution to dissolve electrochemically at a certain potential characteristic of each element. The registered maximum anode current of the element depends linearly on the concentration of the element being determined. The process of electroaccumulation (electrolysis) on the working electrode takes place at a certain electrolysis potential for a given time. It has been established that a relatively high content of *Cd* concentrations of 0.036±0.014 mg/kg was found in tea drinks from black long leaf tea. A low content of *Zn* 0.0033±0.14 mg/kg; *Cd* 0.00098±0.00015 mg/kg; *Pb* 0.044±0.016 mg/kg; *Cu* 0.054±0.020 mg/kg was found, respectively, in lemon juice, canned cucumbers and black tea drinks.

**KEYWORDS:** Cucumber; Lemon; Tea Drink; Toxic Metals; Health; Food Safety

## INTRODUCTION

The relevance of food safety issues is increasing every year, since ensuring the proper quality of food raw materials and food products is one of the main factors determining the absence of a danger to human health when they are consumed. The management of hygienic food safety is one of the priority tasks of the state policy in the field of healthy nutrition and is a necessary condition for ensuring the sanitary and epidemiological well-being of the population [1-3]. At the same time, the quality and safety of agricultural products largely depend on the growing conditions, especially if there is a threat of the presence of toxic substances in the environment, including heavy metal compounds. Pollution with these impurities of natural objects due to anthropogenic activities is a serious global problem [4,5].

In modern conditions, food products contain various amounts of contaminants, mainly below the level of established hygienic standards [6]. However, some contaminants in specific types of food, even within acceptable levels, exert a burden on the human body [7-9]. Long-term chemical loads of low intensity are one of the most significant health risk factors that reduce the body's resistance to the effects of other adverse environmental and socially determined environmental factors [10,11]. Establishing a link between environmental pollution and health effects is difficult due to the nature of exposure pathways, limited data availability and the lack of a monitoring system. Moreover, the relationship between environmental pollution and health is difficult due to the presence of multiple exposures and the latent period of exposure [12,13].

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The need to monitor the safety of products, the study of the possible negative impact of small doses of foreign substances on human health are considered as important scientific and practical problems of hygiene. However, the vast majority of such studies are carried out mainly on models of large industrial cities and centers [11], at the same time, similar problems do not lose their relevance in regions with a relatively smaller population, such as the Lankaran economic region of Azerbaijan. From the point of view of specialization, this economic region mainly performs an agrarian function, while, as a rule, the degree of satisfaction of food needs among the population increases due to locally produced products. This is of particular relevance due to the fact that this region mainly specializes in tea growing, vegetable growing and subtropical crops. As a result, the following task has been set as a priority for the region in the coming years: intensive development of these sectors of agriculture, food and processing industries, quality control and safety of the final product [14].

### Theoretical Justification

At present, the urgent problem for many countries of the world, including the Republic of Azerbaijan, is the problem of the health of the nation. Among many factors, a significant role is played by high-quality, rational nutrition, which is based on fresh and processed fruits and vegetables - the most important source of vitamins, nutrients and minerals, antioxidants that catalyze biochemical reactions in the human body and regulate basic physiological processes [15]. Because fruits and vegetables can absorb heavy metals from the soil, the mineral and metal content of the same fruits and vegetables can vary greatly depending on the soil and region where they are grown. An increased concentration of heavy metals is associated with the etiology of several diseases, especially cardiovascular, neurological and kidney diseases [16,17]. Therefore, we have carried out comprehensive studies of the content of *Zn, Cd, Pb, Cu* in some plant materials, which are carried out in Azerbaijan for the first time.

## OBJECTS AND METHODS OF RESEARCH

### The Objects of the Study were

a) fresh cucumbers grown on the territory of the educational and experimental base of the Lankaran State University and their canned products produced according to generally accepted technology;

b) fresh lemons grown on the territory of the Lankaran tea branch of the Research Institute of Fruit Growing and Tea of the Ministry of Agriculture of the Republic of Azerbaijan and their juices;

c) a tea drink made from green tea leaves grown, zoned and introduced in the farms of the Lankaran-Astara region.

### Research Methods

We have used a technique for measuring the mass concentration of zinc, cadmium, lead and copper in all groups of food products and food raw materials and products of their processing. Mass concentrations of zinc, cadmium, lead and copper are measured by stripping voltammetry after preliminary preparation of samples by "wet" mineralization [18]. The stripping voltammetry method is based on the ability of the elements accumulated on the working electrode from the analyzed solution to dissolve electrochemically at a certain potential characteristic of each element. The registered maximum anode current of the element linearly depends on the concentration of the element being determined. The process of electroaccumulation (electrolysis) on the working electrode takes place at a certain electrolysis potential for a given time. The process of electrodissolution of elements from the electrode surface and registration analytical signals (in the form of peaks on the voltammogram) are carried out at a changing potential. Potentials of the maxima of the registered anodic peaks (analytical signals of *Zn, Cd, Pb* against the background of formic acid) respectively equal: (-0.9±0.10) V, (-0.6±10) V, (-0.4±0.10) V and (-0.1±0.10) V. Repeatability of experiments 3.

When performing measurements, a voltammetric analyzer TA is used, complete with an IBM-compatible computer. The analyzer kit includes:

a) working electrode, mercury-film or modified silver.

b) reference and auxiliary electrodes (silver chloride).

c) cups made of optically transparent quartz, with a capacity of 20-25 $cm^3$.

Range of measurements, values of indicators of accuracy, correctness, repeatability and reproducibility of the technique at a confidence level P=0.95. Chemical interferences that affect the results of the determination of elements are eliminated during sample preparation. The processing of the measurement results and obtaining the result of the analysis under repeatability conditions were performed according to the procedure [18]. The work was carried out in the laboratory "Ecology and safety of food products" of the department "Technology and technical disciplines" of the Lankaran State University and in the educational and methodological laboratory of the department "Engineering and applied sciences" of the Azerbaijan State University of Economics.

## RESULTS AND DISCUSSION

The results of analyzes of the content of *Zn, Cd, Pb, Cu* in canned cucumbers, lemon juice and tea drink from black long leaf tea are shown in the table. As can be seen from the table, a relatively high concentration of *Zn* 0.049±0.00 mg/kg was found in canned cucumbers, *Cd* 0.036±0.014 mg/kg and *Pb* 0.044±0.016 mg/kg in tea drinks from black long leaf tea, *Cu* 0.52 ±0.18 mg/kg in lemon juice. And the lowest content of *Zn* 0.0033±0.14 mg/kg was found in lemon juice; *Cd* 0.00098±0.00015 mg/kg and *Pb* 0.018±0.0063 mg/kg in canned cucumbers, and *Cu* 0.054±0.020 mg/kg was found in black tea drinks. *Cd* is not found in lemon juice at all.

From previous studies [19, 20] it is known that vegetable species differ greatly in their ability to absorb and accumulate heavy metals, even among varieties and varieties of the same species. The voltammogram of the content of mass concentrations of *Zn, Cd, Pb, Cu* in canned cucumbers, lemon juices and tea drinks is shown in Figures 1-3. In one study [21] reported that Pb accumulated significantly in lettuce and onion, while Cd accumulated the most in spinach and lettuce. In another study [22] Chinese leeks, pak choi, and carrots were found to have higher concentrations of Cd in the edible parts than radishes, cucumbers, and tomatoes.

In our studies, as can be seen from Table 1 and figures 1-3, the content of the concentration of *Zn, Cd, Pb, Cu* in the studied raw materials is arranged in the following order: for cucumbers - *Zn > Cu > Pb*, for lemon - *Cu > Pb > Zn*, for tea leaves - *Cu > Zn > Pb > CD*. Differences in the concentrations of toxic metals in canned cucumbers are due to the use of technological methods. So, in the production of canned cucumbers, metals migrate from the raw material to the liquid medium, and if they are absent in the raw material, they can migrate from the liquid medium to the

raw material. The results of the analyzes shown in the table and figures 1-3 show that the total concentrations of all tested toxic metals in tea leaves are higher than in cucumbers and lemons. The voltammograms of the content of mass concentrations of toxic metals, shown in Figures 1-3, also show that the processing of the results of measurements of the mass concentration of each element in the analyzed sample is calculated automatically. In the course of performing measurements in three cells of the analyzer, for each of the elements being determined, three results of a single analysis X1, X2 and X3 are simultaneously obtained under repeatability conditions.

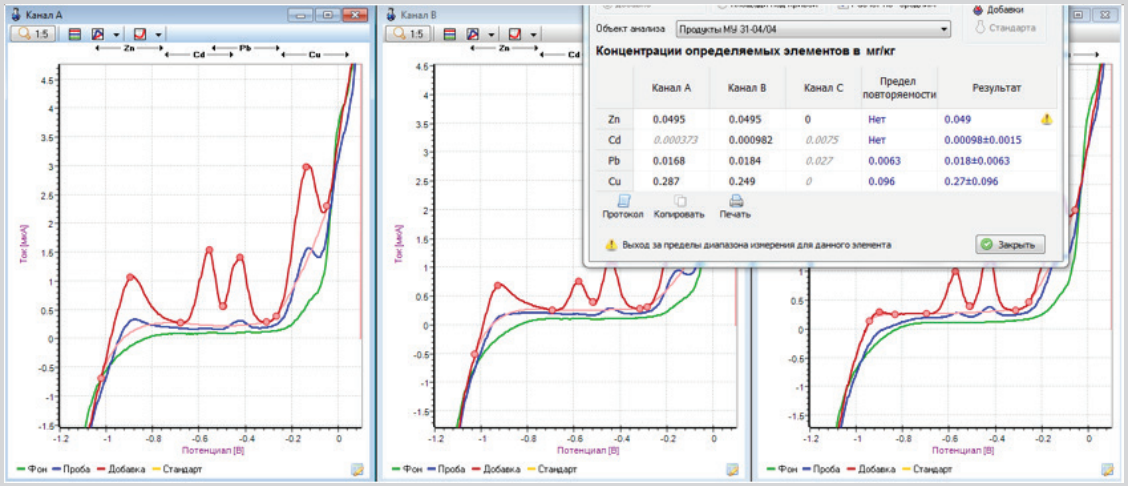


**Figure 1:** Voltamperogram of the content of mass concentrations of *Zn, Cd, Pb, Cu* in canned cucumbers.

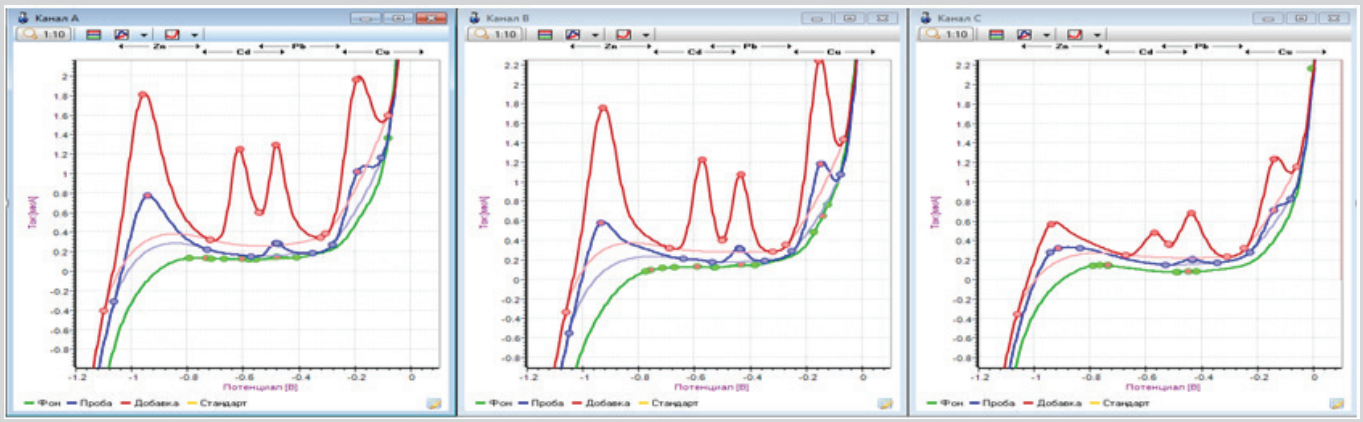


**Figure 2:** Voltamperogram content of mass concentrations of *Zn, Cd, Pb, Cu* in fresh lemons.

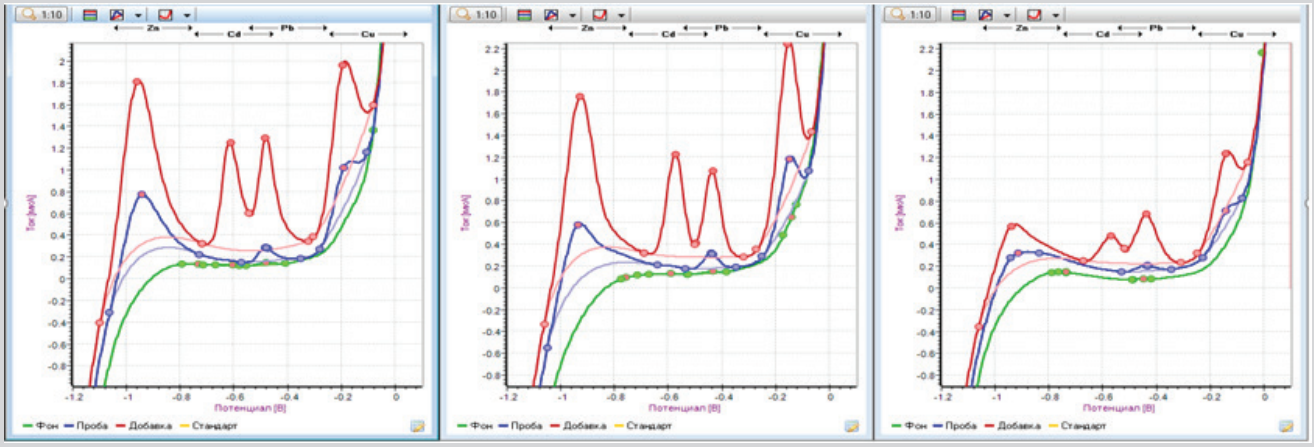


**Figure 3:** Voltamperogram of the content of mass concentrations of *Zn, Cd, Pb, Cu* in drinks from black long leaf tea.

The result of the analysis is taken as the average value of two results of a single analysis, the discrepancy between which does not exceed the limit of repeatability. All this indicates the reliability of the obtained results of analyzes of measurements of the mass concentration of each element in the analyzed sample and the acceptability of this technique. According to the Sanitary and Epidemiological Rules and Norms in force in the Republic of Azerbaijan, the permissible level of *Cd, Pb* in tea products and

canned fruits and vegetables is not more than 1.0 mg/kg and 10.0 mg/kg, respectively.As the results of our studies show, the content of mass concentrations of *Cd, Pb* in all analyzed samples of tea leaves, cucumbers and lemons is less than their permissible levels specified in the current regulatory documents [23]. The content of mass concentrations of Zn, Cu in fresh vegetables, citrus fruits and tea leaves is not standardized by the specified standards.

**Table 1:** Average data on the content of mass concentrations of Zn, Cd, Pb, Cu in some plant raw materials and products of their processing.

| Name of Products | Content of Mass Concentrations, mg/kg | | | |
|---|---|---|---|---|
| | *Zn* | *Cd* | *Pb* | *Cu* |
| Canned cucumbers | 0.049±0.00 | 0.00098±0.00015 | 0.018±0.0063 | 0.27±0.096 |
| Lemon juice | 0.0033±0.14 | 0.00±0.00 | 0.036±0.013 | 0.52±0.18 |
| Black tea drink loose leaf tea | 0.041±0.12 | 0.036±0.014 | 0.044±0.016 | 0.054±0.020 |

## FINDINGS

An analysis of existing literature and patent sources of information shows that some toxic metals such as *Zn, Cd, Pb, Cu* in specific types of food products, even within acceptable levels, have a burden on the human body. *Zn, Cd, Pb, Cu* accumulate in living organisms as a result of various processes that cause adverse effects. In the human body, these heavy metals are transported and separated into the cells and tissues of the body, binding to proteins, nucleic acids destroy these macromolecules and disrupt their cellular functions. As a result of our studies, it was found that relatively high concentrations of Zn 0.049±0.00 mg/kg were found in canned cucumbers, *Cd* 0.036±0.014 mg/kg and *Pb* 0.044±0.016 mg/kg in tea drinks from black long leaf tea, and *Cu* 0.52±0.18 mg/kg in lemon juice. And the lowest content of Zn 0.0033±0.14 mg/kg was found in lemon juice; *Cd* 0.00098±0.00015 mg/kg and Pb 0.018±0.0063 mg/kg in canned cucumbers, and *Cu* 0.054±0.020 mg/kg was found in black tea drinks. The content of mass concentrations of toxic metals *Cd, Pb* in all analyzed samples of tea leaves, vegetables (cucumbers) and citrus fruits (lemons) is less than their permissible levels specified in the current regulatory documents. The content of the concentration of *Zn, Cd, Pb, Cu* in the studied raw materials is arranged in the following order: for cucumbers - *Zn> Cu> Pb*; for lemon - *Cu > Pb > Zn*; for tea leaves - *Cu > Zn > Pb > Cd*. *Cd* was not found in fresh cucumbers and lemons.

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