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COMPARATIVE ANALYSIS OF HEAVY METALS IN TOOTHPASTES

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Abstract:

This article presents a comparative analysis of the amount of heavy metals in toothpastes produced in different countries.

Keywords: Toothpastes, heavy metals, optical emission spectrometry with inductively coupled plasma

INTRODUCTION. There are many types of cosmetics, the composition of which is also different. Cosmetics for various purposes are made using various types of raw materials that have not only different component composition, but also qualitatively and quantitatively different impurities contained in it [1]. Various hygienic means are used to ensure human health. The most common hygiene product is toothpastes. Toothpaste is a complex system, the properties, purpose, mechanism of action and effectiveness of which determine its components. The composition of the toothpaste includes water, abrasives, binding agents, moisturizers, biologically active substances, buffers, detergents, perfumes, flavorings and preservatives [2].

Many ingredients of toothpastes are quite toxic, for example, parabens, fluorides, lauryl sulfates, phosphates and heavy metals.

The amount of heavy metals in toothpastes should not exceed 0.002% [3]. Due to the use of different raw materials of natural and synthetic origin in the production of toothpastes, they may contain different amounts of heavy metal compounds. Among them there are elements that have a positive and negative impact on a person.

When using toothpaste, they can enter the human body through the oral cavity. All this makes it necessary to regulate the requirements for the quality of toothpastes and mandatory control of their safety. Organoleptic and physico-chemical properties of toothpastes must meet the requirements specified in GOST 7983-2016 "Toothpastes" [4]. The most important indicators of the safety of toothpastes are the hydrogen index (pH) of the aqueous suspension and the mass fraction of heavy metals.

The amount of heavy metals in toothpastes was determined by inversion voltammetry [5], polarography [6], potentiometry [7], colorimetry and atom adsorption spectrometry.

The purpose of the study is to determine the amount of heavy metals in toothpastes and make them a comparative analysis.

RESEARCH METHODOLOGY. 4 types of toothpastes of different composition and manufacturer, sold by the retail network of the Republic of Uzbekistan, were selected as samples for the study. Information about the toothpastes studied is given in Table 1.

Table 1
Information about toothpastes

Sample №	Indications	Composition	Country of origin, volume
1	Prevention of caries, gentle whitening	Sodium lauryl sulfate, sodium fluoride, hydrated silicon oxide (IV), sodium hydroxide, triclosan, lemon extract	China, 75 ml
2	Triple protection, healthy gums, strong teeth, fresh breath	PEG-6, PEG-8, sodium fluoride, titanium oxide (IV), sodium lauryl sulfate, hydrated silicon oxide (IV), sodium hydroxide, glycerin, lemon extract	Estonia, 100 ml

3	Refreshing, complex, anti-carious	Sorbitol, water, aroma oils, cellulose gum, cocamidopropyl betaine, sodium fluoride , sodium saccharin, hydroxypropylmethylcellulose, menthol, limonene	Poland, 100 ml
4	Triple effect with chamomile for daily prevention of caries, maintaining the health of teeth and gums	Extracts of rosehip and calendula fruits, aloe vera, sodium lauryl sulfate, hydroxyethyl cellulose, sodium fluoride, sodium saccharinate, titanium oxide, sodium hydroxide, glycerin, sodium benzoate, sodium pyrophosphate, sodium chloride, sorbate	Netherlands, 75 ml

To prepare a diluting solution in a flask with a capacity of 500 ml, 250 ml of purified water, 50 ml of concentrated nitric acid and 10 ml of hydrogen peroxide solution with a volume fraction of 30% were mixed. Purified water was added to bring the volume of the solution to 500 ml. The flask was closed and mixed.
To prepare a standard solution, 1.0 ml of a multi-element solution (10 micrograms/ml) was placed in a measuring flask with a capacity of 100 ml. The volume of the solution was adjusted to 100 ml with dilution solution and mixed well. Two identical sample samples weighing 200±5 mg were carefully weighed and placed in a 50 ml quartz vessel resistant to high pressure, the samples were mineralized for removal volatile substances.
The mineralization device MILESTONE Ethos Easy, Italy, was used for the mineralization of toothpastes. To do this, 6 ml of concentrated nitric acid and 2 ml of hydrogen peroxide solution with a volume fraction of 30% were added to the sample using a graduated pipette. The lid of the container was closed. Within 20 minutes, the whole mixture was mineralized at 180 °C. After mineralization, the sample was cooled at room temperature, 20 ml of distilled water was added to the mineralized solution, the outer walls of the container were rinsed and tightly closed with a lid. Filtered through filter paper, placed in a measuring flask with a capacity of 50 ml and diluted to the required volume with demonized water.
The samples were analyzed using an optical emission spectrometer with inductively coupled plasma Aveo 200 ICP-OES (Perkin Elmer, USA).

The results obtained and their discussion.

The Aveo 200 ICP-OES inductively coupled plasma optical emission spectrometer made it possible to measure with high accuracy 11 heavy metals ((antimony, chromium, arsenic, silver, copper, cadmium, lead, mercury, tin, zinc, iron) in solution during the study. The obtained result is shown in Table 2.

Table 2.
The amount of heavy metals in toothpastes

Elements	The amount of elements in samples is mg / kg			
	Sample №1	Sample №2	Sample №3	Sample №4
Sb	0	0.003	0.012	0.013
Sn	0	0	0	0
Cr	0.004	0.137	0.051	0.052
As	0.012	0.019	0	0
Pb	0	0.036	0.041	0.029
Cd	0	0	0.001	0.0009
Ag	0	0	0	0
Hg	0	0	0	0
Cu	0.085	0.069	0.694	0
Zn	111.5	0.163	0.087	0.301
Fe	0.401	2.904	1.18	1.203

From the data in Table 2, it can be seen that samples of all toothpastes contain elements of chromium (Cr), spirit (Zn) and iron (Fe).Sample 1 (Colgate Total 12) contains the highest spirit element content (111.5 mg/kg), while sample 3 (colgate maxfresh) contains the lowest (0.087 mg/kg). has value. The amount of chromium is 50-800 times smaller than it, and weighs from 0.004 mg/kg to 0.137 mg/kg in samples. The copper element was found in small amounts in samples 1, 2, and 3, and their value does not exceed 0.694 mg/kg. Sample 4 (lesnoy balsam) is not present. One of

the toxic elements was found in samples cadmium No. 3(0.001 mg/kg) and No. 4(0.0009 mg/kg). Cadmium negatively affects the central nervous system, kidneys and liver when it enters the human body. With its carcinogenic nature, it leads to a violation of the exchange of calcium and phosphorus salts.
Of the toxic elements, arsenic (As) was captured in samples No. 1 (0.012 mg/kg) and No. 2 (0.019 mg/kg). Antimony (Sb) did not occur in the first sample, but was found to be present in small amounts in the remaining samples. Heavy metals such as tin (Sn), silver (Ag) and Mercury (Hg) were observed to be absent from samples taken.
The amount of trace elements in toothpastes was observed to increase in the following order:
Sample 1 (Colgate Total 12): increased trace element content in the CR<as<Cu<Fe<Zn series. Antimony, tin, lead, silver, mercury and cadmium are not present.
In sample 2 (Colgate aqua fresh), the Sb<As<Pb<Cu<Cr<Zn<Fe series showed increased levels of microelements that did not include heavy metals such as silver, mercury, cadmium and tin.
Sample 3 (Colgate Max fresh) showed increased heavy metal content in the Cd<Sb<Pb<Cr<Zn<Cu<Fe series. It turned out that the product does not contain elements such as arsenic, silver, tin and mercury.
In sample 4 (Lesnoy Balsam) heavy metals increased by the CD<Sb<Pb<Cr<Zn<Fe array brogan. It did not contain silver, arsenic, tin, mercury and copper.
The total amount of heavy metals in toothpastes is given in Table 3.

Table 3.

Total amount of heavy metals in toothpastes

Samples	Total amount of metals	
	mg/kg	Mass fraction%
Colgate Total 12	112,002	0,0112
Colgate aqua fresh	3,331	0,0003
Colgate Max fresh	2,066	0,0002
Lesnoy balsam	1,5989	0,00016

According to the data in Table 3, the total value of heavy metals has a high indicator in sample №1, (112,002 mg/kg or 0.0112%), indicating that the amount of spirit in it does not conform to San Pin's requirements. The amount of metals contained in the remaining 3 samples corresponds to the requirements of the norm.

CONCLUSION. Thus, when the amount of metals in toothpastes was studied using the inductively coupled plasma optical emission specrtometric method, it was found that all contained chromium, spirit and iron, did not contain heavy metals such as tin, silver and Mercury, and that the amount of spirit was 50-850 times higher than that of other elements. Studies show that the amount of Surma in 3 samples has a negligibly small value. The total amount of heavy metals is in the normative concentration of the 3 toothpastes studied (2, 3 and 4), but the value of sample 1 has the greatest indicator. Although this toothpaste is given as a spirit toothpaste, the fact that its amount has a much higher value negatively affects the human body. A large amount of it causes soul poisoning, headaches, as well as insomnia and tremors.
The results of our study show that toothpastes made in Russia, Slovakia, and Poland are high-quality products, while toothpaste made in China has the lowest quality performance.

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