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# DETERMINATION OF THE CHEMICAL PROPERTIES OF TOOTHPASTES

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**ANNOTATION**
As a result of the determination of the physico-chemical indicators of various toothpastes, their compliance with the regulatory requirements of the hydrogen indicator was observed, the content of the spirit in the composition of one sample in terms of the amount of turn metals has a high value.

**Keywords:** toothpastes, turn metals, physico-chemical indicators.

## INTRODUCTION

To ensure human health, various hygiene products are used. The most common means of hygiene are toothpastes. Toothpaste is a complex system, the properties, purpose, mechanism of action and effectiveness of which are determined by its components [1, p. 97]. The composition of toothpaste includes water, abrasives, binding agents, moisturizers, biologically active substances, buffers, detergents, fragrances, flavorings and preservatives. Many ingredients of toothpastes are quite toxic, for example, parabens, fluorides, lauryl sulfates, phosphates and heavy metals [2, p. 64].

Parabens are esters of para-hydroxybenzoic acid and are used as preservatives. They cause breast cancer and hormonal disorders due to their accumulation in the human body.

Chronic sodium fluoride intoxication causes a bone and joint disease called skeletal fluorosis. Also, fluorides cause infertility, they can damage the human brain and disrupt the function of the thyroid gland [3; 4].

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. The organoleptic characteristics of toothpastes include appearance, taste, color and smell. Physico-chemical indicators include the mass fraction of fluorides and heavy metals. These indicators of toothpastes must meet the requirements specified in GOST 7983-2016 "Toothpastes" and according to the sanitary norm San-PiN 1.2.676. – 97 "Hygienic requirements for the production, quality and safety of oral hygiene products".

The purpose of our work is to determine the hydrogen index (pH) of an aqueous suspension and the mass fraction of heavy metals in various toothpastes.

## MATERIALS AND METHODS

Four different toothpastes were taken for researchInformation about the toothpastes studied is given in Table 1.

Table 1. Information about toothpastes

| Name of the toothpaste | Country of origin | Indications | Main ingredients | Weight |
|---|---|---|---|---|
| Colgate max fresh | China | Protection from caries, prevention of periodontal disease | Hydrated silicon oxide (IV), sodium pyrophosphate, saccharin, methylcellulose | 137g |
| Aquafresh | Estonia | Triple protection, enamel strengthening, protection from action acids | PEG-6, PEG-8, sodium fluoride, titanium oxide (IV), sodium lauryl sulfate, hydrated silicon oxide (IV), sodium hydroxide, glycerin, lemon extract | 125g |
| Colgate Total | Netherlands | Prevention of caries, gentle whitening | Sodium lauryl sulfate, sodium fluoride, hydrated silicon oxide (IV), sodium hydroxide, triclosan, lemon extract | 100g |
| Splat | Russia | Comprehensive care and whitening of sensitive enamel | Sodium lauryl sulfate, sodium bicarbonate, hydroxyapatite, potassium nitrate, titanium oxide (IV), hydrated silicon oxide (IV), zinc citrate | 100g |

Determination of the concentration of hydrogen ions. To prepare an aqueous suspension with a mass fraction of 25% of the product, a sample weighing 25.00 g was weighed on an analytical balance, the result was recorded to the third decimal place. Then 25.00 g of the product was placed in a flask, 75 ml of distilled water was added and stirred with a magnetic stirrer. The experiment to determine the hydrogen index was carried out 3 times and an arithmetic value was obtained [5, c 212].

To prepare the diluting solution, 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 in a 500 ml flask. Purified water was topped up to bring the volume of the solution to 500 ml. The flask was closed and mixed.

For preparation, the standard solution was placed in a 100 ml volumetric flask with a capacity of 1.0 ml of a multi-element solution (10 micrograms/ml). The volume of the solution was adjusted to 100 ml with a diluting solution and mixed well [6, c 60].

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 to remove volatile substances [7, p. 11]. For the mineralization of toothpastes, a MILESTONE Ethos Easy mineralization device was used, Italy. 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 entire mixture was mineralized at 180°C. After mineralization, the sample was cooled at room temperature, 20 ml of demonized 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 [8, c 240; 9, c 432].

The samples were analyzed using an optical emission spectrometer with inductively coupled plasma Avio 200 ISP - OES (Perkin Elmer, USA).

## RESULTS AND DISCUSSION

The main task of measuring the hydrogen index (pH) of toothpastes in an aqueous suspension is to determine their compliance with the standards specified in the technical regulations. The hydrogen index (pH) of toothpastes of aqueous suspensions should be in the range of 5.5-10.5.

Figure 1 shows the results of measuring the pH of a 25% aqueous suspension of toothpastes.

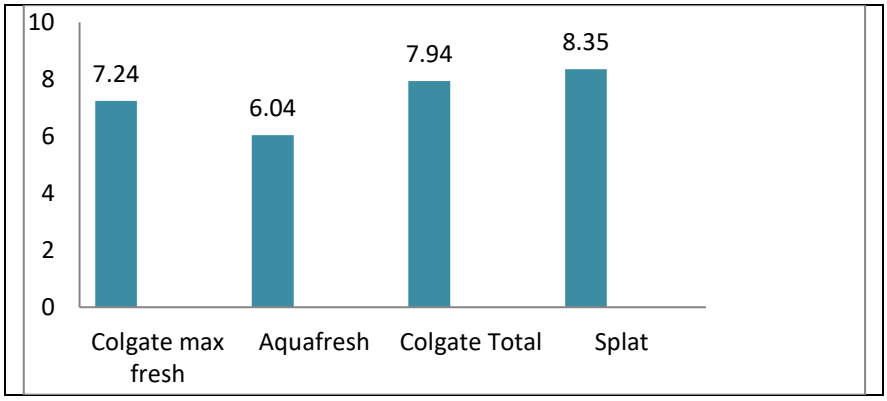


Figure 1. pH values of the investigated toothpastes

The lowest value for the hydrogen index was found in sample 2 (6.04), and the highest value was found in sample 4 (8.35). Thus, the experimental determination of the pH of 25% aqueous suspension of toothpastes allowed us to establish that this indicator meets the requirements of GOST, and does not exceed the range of values regulated by these documents [10].
The optical emission spectrometer with inductively coupled plasma Avio 200 ISP - OES made it possible to measure with high accuracy 11 different 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 content of heavy metals in toothpastes

| № | Name sample | Heavy metals mg/kg | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sb | Sn | Cr | As | Pb | Cd | Ag | Hg | Cu | Zn | Fe |
| 1 | Colgate max fresh | 0 | 0 | 0.004 | 0.012 | 0 | 0 | 0 | 0 | 0.085 | 111.5 | 0.401 |
| 2 | Aquafresh | 0.003 | 0 | 0.137 | 0.019 | 0.036 | 0 | 0 | 0 | 0.069 | 0.163 | 2.904 |
| 3 | Colgate Total | 0.012 | 0 | 0.051 | 0 | 0.041 | 0.001 | 0 | 0 | 0.694 | 0.087 | 1.18 |
| 4 | Splat | 0.013 | 0 | 0.052 | 0 | 0.029 | 0.0009 | 0 | 0 | 0 | 0.301 | 1.203 |

From the table. 2 it can be seen that all samples of the studied types of toothpastes contain chromium, zinc and iron. The most zinc is contained in the sample of toothpaste №1 (111.5 mg/kg), and the least in the sample of toothpaste №3 (0.087 mg/kg). The chromium content in the samples of the studied toothpastes is 50-800 times less and varies from 0.004 mg/kg for №1 to 0.137mg/kg for toothpaste №2. Copper is found only in small amounts in three of the four samples of toothpastes (№1, 2 and 3) and does not exceed 0.694 mg/kg. Such a toxic element as cadmium was found in №3 (0.001mg/kg) and № 4 (0.0009 mg/kg) samples of the studied toothpastes. A toxic element, like arsenic, was found in samples № 1 (0.012mg/kg) and № 2 (0.019mg/kg). Antimony was detected from three samples. Heavy metals such as tin, silver and mercury were not found in any of the 4 samples.
The amount of heavy metals in toothpastes is shown in Table 3.

Table 3. The amount of heavy metals in toothpastes

| № Sample | Total metal content | |
|---|---|---|
| | mg/kg | Weight, % |
| 1 | 112,002 | 0,0112 |
| 2 | 3,331 | 0,0003 |
| 3 | 2,066 | 0,0002 |
| 4 | 1,5989 | 0,00016 |

From the data in Table.3 it was found that the highest total content of heavy metals is characteristic of pastes № 1 (112,002mg/kg or 0.0112%) due to the presence of zinc and exceeds the requirements of the SanPiN [3]. The rest of the samples correspond to the norms.

## CONCLUSIONS

Thus, it can be concluded by optical emission spectrometry with inductively coupled plasma method that the samples of all studied types of toothpastes contain chromium, zinc and iron. At the same time, the zinc content exceeds the chromium content by about 50-850 times. It has been experimentally shown that antimony is contained only in three samples of toothpastes, and in a small amount. Tin, silver and mercury are absent in all the studied samples of toothpastes. The total content of heavy metals in the studied three samples of toothpastes does not exceed the maximum permissible concentration, but the first sample of zinc found a higher concentration of all elements.

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