Volume 3, Issue 6, June 2025 ISSN (E): 2938-3765

EXPERIMENTAL ASSESSMENT OF THE EFFECTIVENESS AND SAFETY OF THE NEW DOMESTIC THERAPEUTIC AND PREVENTIVE TOOTHPASTE

A. N. Akbarov,
N. S. Ziyadullayeva,
M. U. Nurullayeva

Abstract

Diseases related to the teeth rank third (20–25%) among the general morbidity rates of the population and significantly reduce overall quality of life. According to data from the World Health Organization (WHO), the prevalence of pathologies affecting the hard tissues of the teeth and the oral mucosa currently reaches 95–97%

The main and most accessible method of preventing dental diseases is proper use of oral hygiene products. Organic ingredients and natural extracts found in preventive toothpastes help prevent the formation of dental calculus and unpleasant odors. Depending on their active ingredients, therapeutic and prophylactic toothpastes not only provide hygienic benefits but also exhibit antibacterial effects, aid in enamel remineralization, and help reduce hypersensitivity.

However, despite the wide variety of available toothpastes, several disadvantages remain. These include drying effects on the oral mucosa, the need for prolonged use before achieving therapeutic and preventive effects, high abrasiveness, the potential for individual intolerance, and high cost [6,8].

To determine the effectiveness and safety of newly developed toothpaste formulations intended for clinical use, preclinical studies are necessary.

Introduction

Based on the above, the development of locally produced innovative therapeutic and prophylactic agents with new compositions and properties remains a pressing task of interest to chemists as well as specialists from various medical fields, including dentists, dermatologists, immunologists, and endocrinologists.

The aim of this study was to experimentally assess the safety and efficacy of toothpaste formulations containing bioactive glass.

Materials and Methods

As part of the implementation of our research objectives, we developed a locally produced therapeutic and prophylactic toothpaste based on **bioactive glass**.

In addition to the active ingredients, the formulation includes several inactive components commonly used in toothpaste production. These include:

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

- Precipitated chalk (calcium carbonate),
- Xanthan gum,
- Sodium salt of carboxymethyl cellulose (CMC-Na),
- Sodium lauryl sulfate,
- Distilled glycerin,
- Calcium glycerophosphate,
- Preservatives (nipazol and nipagin),
- Stabilizing agents, and
- Distilled water.

These ingredients were combined in specific proportions to ensure stability, safety, and optimal consistency of the final product.

To assess the safety of the toothpaste formulated with bioactive glass, a series of **experimental studies** were conducted on laboratory animals at the **Center for Biomedical Technologies, Tashkent Medical Academy**.

In the first series of experiments, **acute toxicity** was evaluated in adult **white mice** and **rats**. The animals were randomly divided into **six groups** of **six individuals each**. Selection criteria for the laboratory animals included:

- Absence of any clinical signs of disease,
- Homogeneity in terms of **sex** and **body weight** (within ±20%).

These parameters were controlled to minimize biological variability and ensure the reliability of the results obtained during acute toxicity assessment.

The bioactive glass-containing toothpaste was administered to white mice and rats via intragastric gavage at doses of 500, 1000, 2000, 3000, 4000, and 5000 mg/kg. To deliver higher doses of the test substance, it was administered to the animals in multiple stages with 30-minute intervals over a period of 2–3 hours (up to 6 repeated administrations). Animals in the control group received an equivalent volume of distilled water following the same administration schedule.

The general condition of all experimental animals was monitored for 14 days following administration.

Prior to the start of the experiment, as well as throughout its entire duration, the dynamics of body weight gain in the animals were monitored and taken into account.

In the second series of experiments, aimed at studying **chronic toxicity**, a suspension of toothpaste containing bioactive glass was administered intragastrically for 90 consecutive days to 60 white rats weighing between 125 and 145 g.

All animals were divided into 4 groups of 10 rats each as follows:

- Group 1 received toothpaste suspension at a dose of 50 mg/kg,
- Group 2 received 500 mg/kg,
- Group 3 received 1000 mg/kg,
- Group 4 served as the control group and received distilled water daily.

Indicators monitored for toxicity included:

- Absence or presence of mortality, including time of death (if any occurred),
- Behavior of the animals,

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

- Food and water consumption,
- Dynamics of body weight,
- Hematological and biochemical blood parameters,
- Locomotor activity,
- Respiratory rate and depth,
- Condition of fur, skin, and mucous membranes,
- Feces and other relevant clinical signs.

During the experiment, all laboratory animals were kept under standard conditions. All procedures complied with the requirements of the **European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes** (Strasbourg, 1986).

One day after the final procedure, blood samples were collected from the tail vein of animals in all groups. Hematological analyses were performed using the **BS-20S hematology analyzer** (Mindray, China), and biochemical tests were conducted with the **BA-88A biochemical analyzer** (Mindray, China).

Results and Analysis

The results of the acute toxicity study showed that a single intragastric administration of the bioactive glass-containing toothpaste suspension at all tested doses caused no mortality in any of the animal groups over a 14-day observation period.

The experimental animals in all groups maintained physiological levels of activity, with no disturbances in motor coordination. Their skin remained clean without signs of irritation or hyperemia, and the coloration of the fur was unchanged. Sensitivity was preserved. There was no fur loss or any injuries to the head, body, or limbs. Additionally, no signs of skin parasites were detected.

The mucous membranes of the eyes and nose appeared pink, not swollen, and moist. There were no deformities or swelling observed in the extremities.

All animals retained their teeth, and the oral mucosa remained pale pink without visible changes. Food consumption was normal, and bowel movements were regular and consistent.

The study did not reveal any statistically significant differences between the animals receiving various doses of the test preparation and the control animals receiving placebo.

Biochemical blood parameters were analyzed using the **A-25 automatic biochemical analyzer** (BioSystems, Spain). To obtain serum for biochemical analysis, blood samples were centrifuged at **3000 rpm for 15 minutes**. For plasma preparation, **heparin** was added to the blood collection tubes, and the resulting serum was then analyzed using the biochemical analyzer.

To assess the **dynamics of hematological parameters**, the following indicators were measured:

- White blood cells (leukocytes),
- Red blood cells (erythrocytes),
- Hemoglobin,
- Hematocrit,
- Thrombocrit,
- Absolute lymphocyte count,

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

- Absolute counts of monocytes, basophils, and eosinophils,
- Mean corpuscular hemoglobin concentration (MCHC),
- Platelet count in absolute numbers.

Parameters	Groups			
	Control group	Doses (mg/kg)		
		50	500	1000
AlAT, U/l	57,33 ± 3,39	59,67 ± 4,89	54,85 ± 4,74	61,87 ± 5,93
ASAT, U/l	99,43 ± 8,78	105,81 ± 10,29	92,56 ± 9,43	94,98 ± 10,26
ALP, l	218,13±18,97	209,62±15,28	227,15±23,11	230,78±20,02
GGT, U/l	2,83 ± 0,29	3,16 ± 0,30	3,01 ± 0,25	3,50 ± 0,32
Total Bilirubin, µmol/L	7,11 ± 0,50	6,93 ± 0,45	6,74 ± 0,57	6,46 ± 0,52
Cholesterol, mg/dl	68,51 ± 5,17	62,14 ± 5,83	66,01 ± 5,21	59,91 ± 5,44
Glucose, µmol/L	5,31 ± 0,39	5,75 ± 0,41	6,15 ± 0,28	5,87 ± 0,37
Total Protein, g/L	78,28 ± 5,14	80,97 ± 4,64	75,35 ± 5,98	79,11 ± 5,91
Albumin, g/l	40,77 ± 3,62	39,18 ± 3,19	37,37 ± 2,46	39,31 ± 1,93
Urea, mmol/l	6,47 ± 0,50	6,58 ± 0,65	5,83 ± 0,54	5,98 ± 0,49
Creatinine, µmol/L	47,05 ± 2,63	49,70 ± 3,95	51,46 ± 4,95	52,96 ± 5,69

Conclusion

The toothpaste formulated with bioactive glass, administered to animals in both acute and chronic experiments at doses ranging from 50 to 5000 mg/kg, demonstrated **no toxic effects**. This was confirmed by the **absence of mortality and clinical signs of intoxication**, as well as by the **lack of statistically significant changes** in anthropometric, biochemical, hematological, and pathological parameters.

Thus, considering that even doses **100 times higher than the maximum therapeutic level** did not cause toxicity or death in the studied animals, the tested material can be classified as a **Class IV (low-toxicity) substance** according to toxicity classification standards

References:

1. Акбаров А.Н., Зиядуллаева Н.С. Сравнительная оценка новых остеопластических материалов по результатам изучения острой токсичности. RE-HEALTH JOURNAL. 2021; 2(10): P. 203-208.
2. Акбаров А.Н., Зиядуллаева Н.С., Хабилов Б.Н. Гематологические показатели экспериментального изучения хронической токсичности отечественного пастообразного композита. “Stomatologiya” научно-практический журнал Узбекистана, 2020, № 1-2, С. 10-12.
3. Акбаров А.Н., Туляганов Д.У., Зиядуллаева Н.С. Применение инновационных технологий в реконструктивной хирургической стоматологии. Монография, 2022г.
4. Миронов А.Н. Руководство по проведению доклинических исследований лекарственных средств. Часть первая. -М.: Гриф и К, 2012.- 944 с.
5. Akbarov A.N., Ziyadullaeva N.S. Comparative evaluation of new osteoplastic materials based on the results of acute toxicity studies. Uzbek Medical Journal, Tashkent, Issue 2, 2021, P. 29-34.

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

6. Khakimov Z. Z., Babazhanov A. U., Rakhmanov A. Kh et al. Study of the Influence of a New Phytocomposition on Various Phases of Aseptic Inflammation //Advance in Biological Research.2023; 4(1), 25-30.doi: 10.26855/ abr.2023.06.005

Khakimov Z. Z., Rakhmanov A. Kh., Babazhanov A. U. et al. Study of Anti-Inflammatory Activity "Dorusim" // American Journal of Medicine and Medical Sciences 2023, 13(5): 708-712 doi: 10.59.

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5