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(72) **Inventeurs/Inventors:**
BELOUS, ELENA YURIEVNA, RU;
MALTABAR, SVETLANA ALEKSEEVNA, RU;
GALIMOVA, ANNA ZUFAROVNA, RU

(73) **Propriétaire/Owner:**
SPLAT GLOBAL LLC, RU

(74) **Agent:** RIDOUT & MAYBEE LLP

(54) **Titre : COMPLEXE DE MINERAUX ET FERMENTS POUR LE RENFORCEMENT ET LE BLANCHISSEMENT DE L'EMAIL DENTAIRE, COMPOSITION POUR L'HYGIENE BUCCALE ET PATE DENTIFRICE**

(54) **Title: MINERAL-ENZYME COMPLEX FOR STRENGTHENING AND WHITENING TOOTH ENAMEL, ORAL HYGIENE COMPOSITION, AND TOOTHPASTE**

(57) **Abrégé/Abstract:**
The invention relates to the field of cosmetology, namely to mineral-enzyme complexes for tooth enamel strengthening and whitening, and also to compositions for oral hygiene comprising said complex, in particular, to toothpastes and other compositions. The described mineral-enzyme complex for tooth enamel strengthening and whitening is characterized by the fact that it contains calcium hydroxyapatite and tannase with the following component proportions: from 0.2 to 10 parts oftannase per 100 mass parts of calcium hydroxyapatite. The said complex may also additionally contain grapeseed extract. Besides, a variety of compositions for oral hygiene are disclosed that comprise the claimed mineral-enzyme complex. The invention makes it possible to improve consumer properties of the complex and compositions for oral cavity hygiene using the claimed mineral-enzyme complex: cleaning ability, whitening properties, reduction of gum inflammation and gum bleeding, improvement of desensitizing action while retaining remineralizing effect in respect of dental tissues.

ABSTRACT

The invention relates to the field of cosmetology, namely to mineral-enzyme complexes for tooth enamel strengthening and whitening, and also to compositions for oral hygiene comprising said complex, in particular, to toothpastes and other compositions. The described mineral-enzyme complex for tooth enamel strengthening and whitening is characterized by the fact that it contains calcium hydroxyapatite and tannase with the following component proportions: from 0.2 to 10 parts of tannase per 100 mass parts of calcium hydroxyapatite. The said complex may also additionally contain grapeseed extract. Besides, a variety of compositions for oral hygiene are disclosed that comprise the claimed mineral-enzyme complex. The invention makes it possible to improve consumer properties of the complex and compositions for oral cavity hygiene using the claimed mineral-enzyme complex: cleaning ability, whitening properties, reduction of gum inflammation and gum bleeding, improvement of desensitizing action while retaining remineralizing effect in respect of dental tissues.

MINERAL – ENZYME COMPLEX FOR STRENGTHENING AND WHITENING TOOTH ENAMEL, ORAL HYGIENE COMPOSITION, AND TOOTHPASTE

Field of invention.

This invention relates to cosmetology, specifically, to a mineral-enzyme complex for strengthening and whitening tooth enamel, and also to compositions for oral cavity hygiene comprising such complex, in particular, toothpastes and other compositions.

Prior art.

Patent literature comprises many publications disclosing the use of both individual minerals and mineral complexes in a variety of compositions for oral cavity hygiene, in particular, comprising calcium hydroxyapatite (calcium hydroxyphosphate).

Patent RU 2355380 claiming "A tooth elixir for the prevention and treatment of initial dental caries forms" discloses a mineral complex comprising calcium hydroxyapatite – a mineralizor contributing to the changing of tooth enamel mineralization kinetics, and sodium fluoride preventing the adsorption of organic substances and microorganisms on the surface of the enamel and participating in enamel prism formation.

A complex is also known comprising calcium hydroxyapatite and potassium citrate. Potassium citrate reduces the response of nerve fibres in exposed dental tubules to temperature, osmotic and tectile irritants. Calcium hydroxyapatite, in turn, fills dental tubules from the entrance aperture to the depth of the tubule, tightly sealing the entrance itself, which terminates the liquor outflow from dental tubules to the outside. As a result of that, intra-tubular osmotic pressure is restored, and pain syndrome in respect of external irritants is significantly reduced. The complex is designed to improve oral hygiene agent desensitizing action (see A.A. LEONTIEV et al. "Clinical Research of 'Asepta Sensitive' Anti-Sensitive Toothpaste", Stomatology Today, No.7 (87), 2009).

The same source also describes toothpaste, which, beside the described complex, also comprises thermal mud, marigold, melilot and calamus extracts, xylitol and papain enzyme, which taken in a complex, allow the paste to render not just desensitizing, but also anti-inflammation and anti-plaque action.

The use of mineral complexes in oral cavity hygiene compositions allows to improve tooth mineralization, increase enamel resistance etc.

Disadvantages of known complexes include insufficient cleaning properties of the hygienic agents using such complexes, and inadequate tooth whitening.

These deficiencies may be eliminated by using individual enzymes or enzyme complexes in mouth cavity hygiene agents, disclosed quite broadly in the prior art.

Thus, for example, it is known that enzymes in the form of immobilized Bacillus subtilis proteinases, ensure cleaning and anti-inflammation action of mouth cavity hygienic agents (see patent RU2060030), while such enzyme as tannase, when used in oral cavity hygiene agents, helps remove color blemishes since it hydrolizes tannins contained in tea and coffee that cause tooth discoloration, (see specification to patent RU2416391).

Enzymes may be present as a set of substances. Patent RU2355420 discloses a complex of enzyme-active substances comprising papain, lidase, ribonuclease and lysozyme for the purpose of increasing cleaning, anti-microbial and anti-inflammation action, as well as restoration of the natural oral cavity microflora.

Also a toothpaste is disclosed herein using the above complex, comprising the following elements, mass %:

silicium dioxide	10.0-25.0
glycerin	5.0-10.0
PEG 400	2.0-3.0
xylitol	5.0-6.0
disodium EDTA	0.2-1.0
papain	0.2-1.0
lysozyme	0.01-0.4
lactolose	2.0-6.0
sodium carboxy-methylcellulose	0.5-0.7
carbomer	0.2-0.4
ribonuclease	0.001-0.05
lidase	0.005-0.05
sodium lauryl sarcosinate	0.1-1.0
sodium lauryl sulfate	0.5-2.0
cocamidopropyl betaine	0.5-3.0
reduced glutathione	0.001-0.01

Extracts: camomile, parsley	0.05-1.0
grapeseed	0.05-1.0
glucospheres	0.5-3.0
tetrapotassium pyrophosphate	2.0-5.0
tetrasodium pyrophosphate	0.5-2.0
disodium pyrophosphate	0.3-1.0
sodium saccharinate	0.1-0.6
citric acid	0.1-0.4
sodium citrate	0.1-2.0
fir tree extract	0.05-1.0
sage extract	0.05-1.0
chondroitin sulphate	0.1-0.5
betaine	2.0-4.0
aminefluoride	0.19-1.95
sodium fluoride	0.1-0.3
sodium methyl paraben	0.1-0.5
sodium propyl paraben	0.1-0.3
titanium dioxide	0.3-0.5
flavoring agent	0.05-2.0
polyvinyl pyrrolidone	0.1-0.5
demineralized water	10.84-66.893

This complex and toothpaste using the same have whitening and antimicrobial properties, but do not exert a mineralizing effect on the hard tissues of the teeth, strengthen the enamel but weakly, and do not possess sufficient anti-inflammatory action.

As follows from the above sources, calcium hydroxyapatite based complexes provide a solution to the problem of improving dental tissue mineralization, while enzyme based complexes improve teeth whitening, i.e. they are rather narrowly specialized and do not possess the entire range of protective properties. In particular, none of the complexes under study, or any dental hygiene agents containing the same, possesses a combined anti-inflammatory and blood-stopping action along with teeth cleaning and whitening.

Disclosure of the invention.

The objective of this invention is to improve consumer properties of the complex and oral cavity hygiene agents using the claimed mineral-enzyme complex, including: cleaning ability, whitening properties, reduction of gum inflammation and bleeding, and improved desensitizing effect, while retaining the remineralizing effect in respect of dental tissues.

The set objective is achieved through the use of a mineral-enzyme complex for tooth enamel strengthening and whitening, comprising calcium hydroxyapatite and tannase with the following component proportions: 0.2 to 10 parts of tannase per 100 mass parts of calcium hydroxyapatite.

In particular embodiments of the invention, the set objective is achieved by adding grapeseed extract with the following component proportions: 0.2 to 10 parts of tannase and up to 100 mass parts of grapeseed extract per 100 mass parts of calcium hydroxyapatite.

The set objective is also achieved by means of a composition for oral cavity hygiene comprising the above-said mineral-enzyme complex for tooth enamel strengthening in an effective quantity and an appropriate medium.

In particular embodiments of the invention, the said composition may represent a toothpaste, rinsing composition, foaming rinsing composition or a chewing gum.

The set objective is also achieved by means of a toothpaste for oral cavity hygiene comprising the said mineral-enzyme complex for tooth enamel strengthening in an effective quantity and an appropriate medium, said toothpaste additionally comprising substances selected from a group containing abrasive substances, moisturizers, thickeners, surfactants and solvents.

The toothpaste may additionally comprise substances selected from a group containing colorants, preservatives, flavoring agents, anti-oxidizing agents, mineralizing agents, vitamins and mixtures thereof.

In particular embodiments of the invention, a toothpaste comprises a medium containing water as a solvent, silicium dioxide as an abrasive substance, sodium carboxy-methylcellulose as a thickener, at least one moisturizer selected from a group comprising glycerin, sorbitol and polyethylene glycol, and sodium lauryl sarcosinate as a surfactant, with the following component proportions, mass %:

Mineral-enzyme complex	1.50-30.00
Silicium dioxide	1.00 – 60.00

Sodium carboxy-methylcellulose	0.50 – 10.00
Moisturizer	0.50 – 7000
Sodium lauryl sarcosinate	0.01 – 10.00
Water	the rest.

That toothpaste may additionally contain xanthan gum as a thickener in a quantity not exceeding 3 mass %.

The toothpaste may additionally contain substances selected from a group containing foam stabilizers, colorants, preservatives, flavoring agents, anti-oxidizing agents, mineralizing agents, anti-inflammatory binding agents, aseptics, anti-caries agents and mixtures thereof with the following proportions, mass %:

Foam stabilizers	max. 5.00
Colorants	max. 5.00
Preservatives	max. 0.30
Flavoring agents	max. 3.00
Anti-oxidizing agents	max. 5.00
Mineralizing agents	max. 10.00
Anti-inflammatory binding agents	max. 10.00
Aseptics	max. 1.00
Anti-caries agents	max.

The essence of the invention is as follows.

Calcium hydroxyapatitet possesses high adhesion and resorption properties in respect of all types of tissue, both bone and epithelial. As a result of resorption, soft tissues develop a protective coating, and the process of regeneration/granulation is promoted with the generation of new cells and tissues at the place of injury or inflammation.

Tannase is an esterase group enzyme. This enzyme catalyzes hydrolitic cleavage of tannine. There is information in literature that tannase is strictly specific in its action: it disintegrates complex ethers whose acidic component contains at least two phenolic hydroxyls.

We assume that tannase is capable of catalyzing processes in the mouth cavity with the production of anti-baterial substances that enhance, in a non-specific manner, anti-inflammatory properties of calcium hydroxyapatite, at the same time ensuring intensive teeth whitening.

For the claimed complex, it is advisable that amorphous calcium hydroxyapatite with a particle size of 20-80 nm be used. Such calcium hydroxyapatite form does not have abrasive properties while possessing improved biocompatibility with dental tissue.

Research has shown that all the above mineral-enzyme complex components should be gathered together in certain proportions in the complex; in that case, there is a synergetic effect which provides an opportunity to improve tooth enamel and periodontal tissue conditions in a non-liner fashion.

Beyond the claimed proportions of the components, the claimed technical result is not achieved.

The mineral-enzyme complex may contain up to 100 mass parts of grapeseed extract, which further enhances anti-inflammatory properties of the oral cavity hygiene composition.

An oral cavity hygiene composition, in the broadest sense, shall mean composition comprising the above-said mineral-enzyme complex for tooth enamel strengthening as an active ingredient in an effective quantity and an appropriate medium.

An effective mineral-enzyme complex quantity may be different depending on the type of composition, particular sets of ingredients or a combination of substances in the complex etc.

Such effective quantity in any individual case may be determined by a professional versed in the field by means of ordinary experiments.

For certain embodiments of the invention (toothpaste) such quantity has been identified by us and cited in the claims of the invention.

An appropriate medium shall mean such that enables to obtain a desired oral cavity hygiene composition in the form of e.g. toothpaste, rinse liquid, tooth powder, gel, foaming rinse, chewing gum etc. In that sense, a composition under the present invention may be represented by a liquid, i.e. a solution of ingredients, e.g. a mouth rinsing liquid; or it may be semi-hard, as for example toothpaste or tooth cleaning gel; or it may be hard, e.g. chewing gum.

If the composition hereunder is a liquid, e.g. a mouth rinsing liquid, then an appropriate medium is represented, as a rule, by a water-glycerin mixture (traditional rinse) or glycerin (high sensitivity dental rinse or applications). Solubilizers and other useful additives may be added to the rinse composition. In particular, the base of the foaming rinse, beside solubilizers, additionally contains surfactants and a foam stabilizing agent.

If the composition is a chewing gum, then an appropriate medium comprises synthetic or natural polymers with plastifiers, flavoring agents, preservatives, sweeteners and other additives.

If the composition is a toothpaste, then an appropriate medium shall comprise solvents, thickeners, surfactants, abrasive substances, emulsifiers, solubilizers, moisturizers, sweeteners, flavoring agents, preservatives and mixtures thereof.

An analysis of prior art shows that for a toothpaste, the abrasive content fluctuates from about 5 to about 60 mass %, which corresponds to the abrasive content of the claimed toothpaste. Abrasive substances prefereable for use in the present invention include silicium dioxide based materials, represented in the invention examples below by Sorbosil (by PQ Corporation) and Tixosil (by Rhodia). However, that list of abrasives is not exhaustive, it being possible to use such substances as abrasive agents as aluminum oxide, calcium carbonate, sodium metaphosphate, potassium metaphosphate, tricalcium phosphate, dehydrated dicalcium phosphate, aluminum silicate, calcined aluminum oxide, bentonite or other silicium based materials or combinations thereof.

An appropriate medium applicable for the obtaining of the composition hereunder in the form of a paste or foaming rinse may comprise a moisturizer. A moisturizer is preferably represented by sorbitol, glycerin and/or polyethylene glycol PEG 400; however, other moisturizers and mixtures thereof with a molecular mass in the range of 200-1000 may also be used. In prior art technical solutions, moisturizer concentrations are usually in the range of from about 0.5 to about 70% of the composition mass.

As a rule, thickeners are present in oral hygiene compositions in quantitites of up to 10 mass %. Thickeners include natural and synthetic resins and colloids. In the present invention, the thickener is represented by sodium carboxy-methylcellulose; besides, the thickener functions are also performed by the above discussed silicium dioxide.

Any of the above listed compositions may additionally contain any appropriate flavoring or sweetening substances.

Toothpastes may additionally comprise a variety of other substances including preservatives, such as methylparaben, sodium methylparaben and chlorophyllic compounds. Such auxiliary substances shall be introduced into compositions hereunder in quantities that do not have an adverse affect on the desired properties and characteristics.

The introduction of emulsion stabilizers in the paste ensures a dispersed state of fats and oils in water emulsions.

Requirements to stabilizers are as follows: ensuring composition stability, inertness to other composition components, no irritating action, non-toxicity, no offensive odor. All of the above requirements are satisfied by Polydon-A, tetrasodium glutamate diacetate and disodium EDTA (Trilon BD), used in particular embodiments of the invention.

A toothpaste may comprise surfactants and, in particular, anionic surfactants, such as sodium lauryl sulphate, sodium myristoyl sarcosinate, cocamidopropyl betaine and sodium lauryl sarcosinate, which possess a multi-functional action: solubilizing, dispersing and moisturizing. Moreover, their function is to form emulsions with other components of oral cavity hygiene compositions, including those with flavoring additives. Beside the above-listed surfactants, other anionic surfactants may also be used, as well as cationic, non-ionic, amphoteric and zwitter-ionic surfactants, or mixtures thereof.

The effect of a surfactant consists in its contribution to the foaming of a toothpaste. The introduction of surfactant with a high degree of foaming contributes to the sensation of effective oral cavity cleaning.

Compositions for oral cavity hygiene according to the present invention may be obtained by mixing the ingredients.

Table 1 provides toothpaste compositions using the claimed mineral-enzyme complex.

Tables 2-4 provide compositions of a variety of rinses using the claimed mineral-enzyme complex.

Table 5 shows the composition of a chewing gum using the claimed mineral-enzyme complex.

Example 1.

To produce toothpaste, complexes of different compositions were used as a mineral-enzyme complex (see footnotes to tables 1-5).

The toothpaste of compositions shown in table 1 was produced as follows: a moisturizer, e.g. glycerin, sorbitol, or polyethylene glycol, was dispersed in water under mixing in a conventional mixer. To the dispersion were added thickeners, a sweetener, a preservative, any active salts and foam stabilizers. To the gel phase were added colorants and a pigment, such as TiO_2. If

the paste was not gel-like, then any acid or base needed to control pH was added. Those ingredients were mixed to obtain a homogenious phase. Then the mixture was transferred to a high-speed vacuum mixer, wherein an inorganic silicium dioxide based thickener was added to the mixture, and then, in sequence, a silicium dioxide based abrasive along with other abrasive substances to be used in the composition, and finally the mineral-enzyme complex, were added. The mineral-enzyme complex was, prior to introduction, a transparent colorless liquid with white suspension or residue, possessing a specific faint taste and odor, and having a pH of a 5% solution of 7.0-8.0.

Also flavoring agents and surfactants were added, with any component insoluble in water introduced with a moisturizer. The obtained product was in each case a homogeneous semi-hard paste or gel.

The pastes obtained were tested according to the procedure described below.

In the course of control check-ups, the condition of oral cavity hygiene, hard dental tissues, periodontal tissues and oral mucosa was determined according to the criteria described below.

Research material and methods.

Tests were conducted with composition C of table 1 and experimental toothpaste composition D with calcium hydroxyapatite (~ 10 mass %) but without tannase.

Trial use of the claimed toothpaste was conducted by individuals with high tooth sensitivity. Altogether, 480 teeth with hypersensitivity were identified in test objects, 6 hypersensitive teeth per test object, on average. Depending on the paste version, test objects were divided into 4 groups:

1 group – composition C toothpaste

2 group – composition D toothpaste

The trial conducted was a double-blind randomized one.

The toothpastes were used by the test objects by themselves twice a day (in the morning and at night), for the period of one month. After the primary check-up, follow-up checks were conducted once a week, for the period of four weeks.

1.1. Study of the cleaning action and cleaning effect

To determine cleaning action, the oral hygiene (Greene and Vermillion) index was used; in the process, PARO disclosing tablets were used.

The cleaning effect was determined by oral hygiene (Greene and Vermillion) index data according to the following formula:

$$\text{Effect (\%)} = [100 \times (OHI_0 - OHI_n)]/ OHI_0$$

where OHI_0 is index value at research start, prior to hygienic procedure;

OHI_n is index value after n weeks of research, at the last check-up prior to hygienic procedure.

Table 6 shows data on the oral hygiene index dynamics during the four-week period.

1.2. Sensitivity study: tactile and thermal tests

The degree of hyperesthesia severity in gum recession areas prior to and at different times during the use of the toothpaste was determined by diagnostic tests:

1. Probing:

a) cotton swab (CS) tactile sensitivity test;

b) linear probe movement over the tooth surface (LPM).

2. Thermometry:

a) rinsing with a water stream (WSBC);

b) processing with a direct air stream (DAS);

c) processing with a lateral air stream (LAS).

Table 7 shows data on sensitivity dynamics based on diagnostic tests.

1.3. Study of desensitizing action and desensitizing effect

The tooth sensitivity index by L.Yu. Orekhova and S.B. Ulitovsky (TS Orekhova-Ulitovsky index) is determined according to parameters shown in table 4. That index makes it possible to trace teeth condition changes under the influence of desensitizing agents used.

Thus, the TS Orekhova-Ulitovsky index is a sum of values of all described criteria divided by the number of the criteria and multiplied by 100.

$$\text{TS Orekhova-Ulitovsky index} = \frac{\sum (a_1 + \ldots + a_n)}{5n} \times 100$$

where $\sum$ is the sum of criteria quantitative values;

a_1 – number of points for the first criterion;

a_n – number of points for the n-th criterion;

n – number of criteria used;

5 – number of assessed parameters inside each criterion.

In out problem, the number of criteria and parameters is stable being equal to 11 and 55, respectively. Thus, the formula will look as follows:

$$\text{TS Orekhova-Ulitovsky index} = \frac{\sum (a_1 + \ldots + a_{11})}{55} \times 100$$

In the denominator, the sum of points for criteria fluctuates in the range of $11 \leq (a_1 + \ldots a_{11}) \leq 55$, and the index boundaries are $20 \leq$ TS Orekhova-Ulitovsky index ≤ 100.

Assessment criteria:

81 – 100% - very severe condition;

61 – 80% - severe condition;

between 41 and 60% - relatively compensated tooth sensitivity;

between 21 and 40% - compensated condition against the background of the existing light compensated tooth sensitivity condition;

20% - the tooth (teeth group) healthy with a normal natural sensitivity to external irritants.

In order to study tooth sensitivity for a long time in dynamics, especially under the influence of medication or locally applied oral hygiene aids, we use the Tooth Sensitivity Effectiveness calculation formula (TS Effectiveness):

$$\text{TS Effectiveness (\%)} = [(I_1 - I_n) \times 100] / I_1$$

where

I_1 is Orekhova-Ulitovsky TS index value determined during the first visit;

I_n is Orekhova-Ulitovsky TS index value determined during the n-th visit.

Table 8 shows data related to desensitization effectiveness dynamics based on Orekhova-Ulitovsky TS index in the period when the toothpastes were used.

1.4. Study of whitening action and whitening effectiveness

The whitening effect was determined prior to and at different times of toothpaste use by the VITAPAN scale. After determining the initial values by the VITAPAN scale, correctness of hygienic treatment (tooth cleaning methods and regimen compliance) was examined; appropriate tutoring was conducted as needed.

Table 9 shows data on whitening action dynamics in the period of toothpaste research by the VITAPAN scale.

1.5. Study of remineralizing action and remineralizing effectiveness

The study of remineralizing action was conducted with the help of the TER-test (test of enamel resistance) according to Okushko. Remineralizing effectiveness was calculated on the basis thereof.

Table 10 shows data on remineralizing effectiveness dynamics based on TER-test.

1.6. Study of anti-inflammatory action and anti-inflammatory effectiveness

To determine the periodontal tissue condition, PMA indices were used.

Anti-inflammatory effectiveness was determined on the basis of the obtained values of PMA indices, said effectiveness testifying to the nature of changes in the inflammatory process of the periodontium.

Anti-inflammatory effectiveness was determined according to the following formula:

$$\text{Anti-inflammatory effectiveness (\%)} = [100 \times (PMA_0 - PMA_n)] / PMA_0,$$

where

PMA_0 is index value prior to research start;

PMA_n is index value on expiration of n weeks of research, during the final examination.

Table 11 shows data on toothpaste anti-inflammatory effectiveness dynamics based on PMA index.

1.7. Study of blood stopping action and blood stopping effectiveness

To determine the periodontal tissue condition, Muhlemann and Mazor's bleeding index was used.

Based on the obtained bleeding index results, blood-stopping effectiveness was determined testifying to the nature of changes in the inflammatory process of the periodontium.

Blood-stopping effectiveness was determined by the formula:

$$\text{Blood-stopping effectiveness (\%)} = [100 \times (BI_0 - BI_n)] / BI_{,0}$$

where BI_0 is index value prior to research start;

BI_n is index value on expiration of n weeks of research, during the final examination.

Table 12 shows data on blood-stopping effectiveness.

The obtained results allow to make the conclusion that group 1 that used the claimed composition (composition C) for teeth cleaning demonstrated cleaning effect (41.8%), desensitizing effectiveness (22.1%), whitening effectiveness (42.86%), remineralizing effectiveness (27.3%), anti-inflammatory effectiveness (42.1%), and blood-stopping effectiveness (26.1%).

When the control composition D was used, the majority of indicators were lower, except certain individual indicators (desensitizing and remineralizing effectiveness) that coincided.

Table 1 Composition of toothpastes containing the claimed mineral-enzyme complex.

Ser. #	Component	Toothpaste compositions, mass %					Function
		Composition A[1]	Composition B[2]	Composition C[3]	Composition D[4]	Content range	
1.	Mineral-enzyme complex	6.06	1.52	10.05	11.10	1.50-30.00	Source of mineral substances and tannase enzyme; contributes to strengthening and whitening of enamel, reduction of tooth sensitivity, possesses anti-inflammatory and blood-stopping properties
2.	Sorbitol 70%	30.00	20.00	20.00	20.0	1.00-60.00	Moisturizer. Influences the product texture imparting special softness and plasticity thereto.
3.	Glycerin (99.7%)	10.00	5.00	5.00	5.00	0.50-70.00	Moisturizer. Contributes to obtaining a plastic, thixotropic mass, stabilizes foam, improves toothpaste flavor.
4.	Polyethylene glycol PEG 400	-	5.00	5.00	-	0.10-20.00	Moisturizer. Influences the product texture imparting special softness and plasticity thereto.
5.	Silicium dioxide	10.0-	16.0	10.0	15	1.00-60.00	Thickener and/or abrasive

[1] In the mineral-enzyme complex, 0.2 mass parts of tannase and 0.8 mass parts of grapeseed extract are taken per 100 mass parts of hydroxyapatite.

[2] In the mineral-enzyme complex, 2 mass parts of tannase and 50 mass parts of grapeseed extract are taken per 100 mass parts of hydroxyapatite.

[3] In the mineral-enzyme complex, 0.5 mass parts of tannase are taken per 100 mass parts of hydroxyapatite

[4] In the mineral-enzyme complex, 2 mass parts of tannase and 100 mass parts of grapeseed extract are taken per 100 mass parts of hydroxyapatite

6.	Sodium carboxy-methylcellulose	1.00	1.5	1.50	1.50	0.5-10.00	Thickener, structure-forming agent
7.	Xanthan gum	0.10	-	-	-	0.02-3	Thickener, structure-forming agent
8.	Sodium myristoyl sarcosinate	4.00	-	-	-	2.00-5.00	Surfactant
9.	Cocamidopropyl betaine	-	1.00	-	-	0.01-10.00	Surfactant
10.	Sodium lauryl sarcosinate	-	1.00	3.0	-	0.01-10.00	Surfactant
11.	Sodium lauryl sulphate (sodium coco-sulphate)	-	-	-	2.0	0.01-10.00	Surfactant
12.	Stevia extract	0.20	-	0.20	0.20	0.05-3	Sweetener
13.	Xylitol	-	0.50	1.0	-	0.01-1	Sweetener
14.	Sucralose		0.05			0.01-1	Sweetener
15.	Flavoring agent	0.50	1.0	1.0	1.0	0.05-3	Flavoring additive
16.	Sodium methylparaben	0.30	0.25		0.300	0.05-0.3	Preservative
17.	Titanium dioxide		0.10	0.10	0.10	0.01-5.00	Whitening agent, colorant
18.	Anise camphor	0.150	-	-	-	0.01-1	Polyphenol, aseptic
19.	Eucalyptol	0.10	-	-	-	0.01-1	Polyphenol, aseptic
20.	Thymol	0.08	-	-	-	0.01-1	Polyphenol, aseptic
21.	Isopropyl methylphenol	0.100	-	0.10	-	0.01-0.2	Aseptic, caries prevention
22.	Sodium monofluorophosphate	-	-	0.50	-	0.01-10.00	Anti-caries agent
23.	Aminefluoride	-	-	1.00	-	0.01-10.00	Anti-caries agent
24.	Vitamin E	0.10	-	-	0.10	0.01-5.00	Anti-oxidizing agent, anti-inflammatory

							action
25.	Tetrasodium glutamate diacetate	0.50	-	-		0.01-5.00	Foam stabilizer, chelating and whitening agent
26.	Polydon A	-	-	0.90	-	0.01-5.00	Foam stabilizer, whitening agent
27.	Trilon BD (disodium EDTA)	-	0.05	0.05	-	0.01-5.00	Foam stabilizer, chelating and whitening agent
28.	Calcium lactate	-	-	-	1.00	0.01-10.00	Mineralizing agent
29.	Citric acid	0.10	0.20	-	-	0.0001-0.50	Acidity regulating agent
30.	Dry skullcap extract	-	0.10	-	-	0.01-10.00	Anti-inflammatory, binding, blood-stopping agent
31.	Dry bergenia extract	-	0.10	-	-	0.01-10.00	Anti-inflammatory, binding, blood-stopping agent
32.	Neem extract	-	0.05	-	-	0.005-5.00	Antibacterial agent
33.	Water	Up to 100%					Solvent

Table 2 Rinse composition

Ser. #	Composition component	Composition, mass %	Function
1	Mineral-enzyme complex[5]	1.60	Contributes to strengthening and whitening of enamel, reduction of tooth sensitivity, possesses anti-inflammatory and blood-stopping properties
2	Glycerin (99.7%)	5.00	Moisturizer, solvent
3	Trilon BD (disodium EDTA)	0.05	Stabilizer, chelating and whitening agent
4	Sucralose	0.05	Sweetener
5	Sodium methylparaben	0.30	Preservative
7	Xanthan gum	0.50	Thickener, structure-forming agent
8	Calcium lactate	1.00	Mineralizing agent
9	Polyethylene glycol PEG 400	5.00	Moisturizer.
10	Thymol 001-017	0.08	Polyphenol, aseptic
11	PEG-40 hydrogenized castor oil	1.00	Moisturizer, solubilizer
13	Vitamin E	0.05	Anti-oxidizing agent, anti-inflammatory action
14	Flavoring agent	0.30	Flavoring additive
15	Anise camphor	0.10	Polyphenol, aseptic
16	Eucalyptol	0.05	Polyphenol, aseptic
18	Citric acid (dry)	0.20	Acidity regulating agent
19	Purified water	Up to 100%	Solvent

[5] In the mineral-enzyme complex, 10 mass parts of tannase and 50 mass parts of grapeseed extract are taken per 100 mass parts of hydroxyapatite.

Table 3. Composition for rinsing and application for highly sensitive teeth

Ser. #	Composition component	Composition, mass %	Function
1	Mineral-enzyme complex[6]	20.15	Source of mineral substances and tannase enzyme; contributes to strengthening and whitening of enamel, reduction of tooth sensitivity, possesses anti-inflammatory and blood-stopping properties
2	Glycerin (99.7%)	Up to 100%	Moisturizer. Contributes to obtaining a plastic, thixotropic mass, stabilizes foam, improves toothpaste flavor.
3	Japanese honeysuckle extract	1.00	Antibacterial agent
4	p-methoxybenzoic acid	0.10	Antibacterial agent
5	Glyceryl monocaprilate (Cosphaderm GMCY)	0.10	Antibacterial agent

[6] In the mineral-enzyme complex, 0.25 mass parts of tannase and 0.5 mass parts of grapeseed extract are taken per 100 mass parts of hydroxyapatite.

Table 4. Foaming rinse composition

Ser. #	Composition component	Composition, mass %	Function
1.	Mineral-enzyme complex[7]	0.71	Source of mineral substances and tannase enzyme; contributes to strengthening and whitening of enamel, reduction of tooth sensitivity, possesses anti-inflammatory and blood-stopping properties
2.	Sorbitol 70%	10.00	Moisturizer. Influences the product texture imparting special softness and plasticity thereto.
3.	Trilon BD (disodium EDTA)	0.10	Stabilizer, chelating and whitening agent
4.	Sodium methylparaben	0.25	Preservative
5.	L-arginine	0.100	Acidity regulating agent
6.	Sucralose	0.05	Sweetener
7.	Liquorice extract	0.05	Anti-inflammatory and anti-caries agent
8.	Sodium lauryl sarcosinate	4.00	Surfactant
9.	Polyvinyl pyrrolidone/vinylacetate	1.00	Whitening agent, foam stabilizer
10.	Flavoring agent	1.00	Flavoring additive
11.	PEG-40	1.00	Moisturizer, solubilizer
12.	polysorbate - 20	1.00	Moisturizer, solubilizer
13.	carragheenan	0.05	Foam stabilizer
14.	Citric acid	0.20	Acidity regulating agent
15.	Enzyme complex: lactoferrin, lactoperoxidase, glucose oxidase, potassium thiocyanate, glucose pentaacetate	0.50	Antibacterial agent
16.	Purified water	Up to 100%	Solvent

[7] In the mineral-enzyme complex, 0.25 mass parts of tannase and 0.5 mass parts of grapeseed extract are taken per 100 mass parts of hydroxyapatite.

Table 5. Chewing gum composition.

Ser.#	Composition component	Composition, mass %	Function
17.	Mineral-enzyme complex[8]	2.11	Source of mineral substances and tannase enzyme; contributes to strengthening and whitening of enamel, reduction of tooth sensitivity, possesses anti-inflammatory and blood-stopping properties
4	Elastic/rubber base	Up to 100%	Base
5	Xylitol	10.000	Sweetener, anti-caries agent
6	Flavoring agent	0.200	Flavoring additive
7	Glycerin (99.7%)	2.000	Moisturizer.

[8] In the mineral-enzyme complex, 5 mass parts of tannase and 0.5 mass parts of grapeseed extract are taken per 100 mass parts of hydroxyapatite.

Table 6 Oral hygiene (Greene-Vermillion) index dynamics in the period of four weeks

Ser.#	Distribution by group	Examination period				
		Start	Week 1	Week 2	Week 3	Week 4
1	Composition C	3.80	3.32	2.93	2.57	2.21
2	Composition D	3.69	3.28	2.89	2.49	2.26

Table 7 Sensitivity dynamics on the basis of diagnostic tests

Diagnostic tests	In 1 week		In 2 weeks		In 3 weeks		In 4 weeks	
Compositions	C	D	C	D	C	D	C	D
LPM	8.9	10.0	17.1	16.1	22.9	25.8	31.4	32.3
CS	10.3	12.0	13.8	16.0	24.1	28.0	34.5	36.0
WS	8.8	9.5	11.6	13.6	20.4	21.1	30.4	32.8
LAS	9.3	9.6	14.1	15.0	18.4	23.6	32.3	33.4
DAS	10.6	10.8	18.8	19.0	22.4	24.5	32.8	33.8

Table 8 Desensitizing effectiveness dynamics by Orekhova-Ulitovsky TS index in the period of toothpaste use

Distribution by group	Examination period			
	Week 1	Week 2	Week 3	Week 4
Composition C	6.8%	11.4%	16.5%	22.1%
Composition D	7.0%	11.7%	17.9%	22.0%

Table 9 Whitening action dynamics in the period of toothpaste examination by VITAPAN scale

Distribution by group	Examination period				
	Initial	In 1 week	In 2 weeks	In 3 weeks	In 4 weeks
Composition C	A3.5	A3.5	A3	A2	A2
Composition D	A3.5	A3.5	A3.5	A3	A2.5

Table 10 Remineralizing effectiveness dynamics by TER-test

Distribution by group	Examination period			
	Week 1	Week 2	Week 3	Week 4
Composition C	9.1%	18.2%	27.3%	27.3%
Composition D	10.0%	20.0%	30.0%	30.0%

Table 11 Toothpaste anti-inflammatory effectiveness dynamics by PMA index

Distribution by group	Examination period			
	Week 1	Week 2	Week 3	Week 4
Composition C	7.1%	14.9%	23.6%	42.1%
Composition D	5.8%	10.5%	21.1%	38.9%

Table 12 Blood-stopping effectiveness

Distribution by group	Examination period			
	Week 1	Week 2	Week 3	Week 4
Composition C	8.3%	13.0%	20.9%	26.1%
Composition D	5.5%	8.5%	11.0%	14.5%

CLAIMS:

1. A mineral-enzyme complex for tooth enamel strengthening and whitening, comprising calcium hydroxyapatite and tannase with the following component proportions: from 0.2 to 10 parts of tannase per 100 mass parts of calcium hydroxyapatite.

2. A mineral-enzyme complex according to claim 1, further comprising grapeseed extract with the following component proportions: from 0.2 to 10 parts of tannase and up to 100 mass parts of grapeseed extract per 100 mass parts of calcium hydroxyapatite.

3. A composition for oral cavity hygiene, comprising a mineral-enzyme complex for tooth enamel strengthening and whitening according to claim 1 or claim 2 in an effective quantity and an appropriate medium.

4. A composition according to claim 3, wherein the composition is represented by a toothpaste.

5. A composition according to claim 3 wherein the composition is represented by a rinsing composition.

6. A composition according to claim 3, wherein the composition is represented by a foaming rinsing composition.

7. A composition according to claim 3, wherein the composition is represented by a chewing gum.

8. A toothpaste for oral cavity hygiene, comprising a mineral-enzyme complex for tooth enamel strengthening and whitening according to claim 1 or claim 2 in an effective quantity, and an appropriate medium comprising substances selected from a group consisting of abrasive substances, moisturizers, thickeners, surfactants and solvents.

9. A toothpaste according to claim 8, further comprising a medium comprising water as a solvent, silicium dioxide as an abrasive substance, sodium carboxy-methylcellulose as a thickener, at least one moisturizer selected from a group consisting of glycerin, sorbitol and polyethylene glycol, and sodium lauryl sarcosinate as a surfactant, with the following component proportions, mass %:

Mineral-enzyme complex	1.50 - 30.00

Silicium dioxide	1.00 - 60.00
Sodium carboxy-methylcellulose	0.50 - 10.00
Moisturizer	0.50 - 70.00
Sodium lauryl sarcosinate	0.01 - 10.00
Water	the rest.

10. A toothpaste according to claim 8 or claim 9, further comprising xanthan gum as a thickener in a quantity not exceeding 3 mass %.

11. A toothpaste according to any one of claims 8 to 10, further comprising substances selected from a group consisting of foam stabilizers, colorants, preservatives, flavoring agents, anti-oxidizing agents, mineralizing agents, anti-inflammatory binding agents, aseptics, anti-caries agents and mixtures thereof with the following component proportions, mass %:

Foam stabilizers	max. 5.00
Colorants	max. 5.00
Preservatives	max. 0.30
Flavoring agents	max. 3.00
Anti-oxidizing agents	max. 5.00
Mineralizing agents	max. 10.00
Anti-inflammatory binding agents	max. 10.00
Aseptics	max. 1.00
Anti-caries agents	max. 10.00.