

SPECIFICATION

TITLE OF THE INVENTION

COMPOSITION FOR CARIES PREVENTION

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a composition for oral cavity to prevent a caries, which has effects for suppressing tooth demineralization and promoting tooth remineralization.

Description of the Conventional Art

Conventionally, as a component for the caries prevention, casein phosphopeptide - amorphous calcium phosphate complex (hereinafter, it is referred to as CPP - ACP) has been known. The CPP - ACP is a material comprising a complex of peptide derived from milk protein (casein) and an inorganic material (an amorphous calcium phosphate), and it has been said that the CPP - ACP act on demineralization and remineralization of the tooth since it contains calcium and phosphorus, which are an inorganic components of the tooth, as the constituent elements (for example, refer to non-patent literature 1, Reynolds EC et al. "Anticariogenicity of calcium phosphate complexes of tryptic casein phosphopeptides in the rat" J Dent Res. 1995 Jun : 74(6) : 1272-9, and

non-patent literature 2, Reynolds EC
"Remineralization of enamel subsurface lesions by
casein phosphopeptide - stabilized calcium phosphate
solutions" J Dent Res. 1997 Sep : 76(9) : 1587-95.)

As for the caries prevention with the CPP - ACP,
two processes comprising an acceleration of
remineralization action and an inhibition of
demineralization action are considered. The
acceleration of remineralization action can be
explained by the results, where the concentrations of
calcium and phosphorus can be continuously increased
and kept in the inside of a demineralized lesions under
the enamel subsurface, by continuously supplying the
CPP - ACP. Furthermore, the inhibition of
demineralization action is based on the following
logic, where the solubility of calcium phosphate in
the enamel subsurface is remarkably decreased since
the ion concentration in saliva on the enamel
subsurface or the inside of a dental plaque is kept
in the supersaturated state with the ions of calcium
and phosphorus came from the CPP - ACP, and then, the
tooth becomes to be hardly melted.

Moreover, it has been known that fluorides have
many effects for promoting the remineralization,
improving an acid resistance of tooth structure, and

suppressing an acid production with exhibiting antimicrobial property to plaque bacteria, and thus a casein phosphopeptide - amorphous calcium fluoride phosphate complex (hereinafter it is referred to as CPP - ACFP), which contains fluorides, has also effect for the caries prevention.

The foods, such as a chewing gum and a candy, and the compositions for oral care, such as a dentifrice and a mouth washing agent, which assist the caries prevention by containing the CPP - ACP and CPP - ACFP having the above action, have been disclosed (for example, refer to patent literatures 1, published Japanese translations of PCT international publication for patent application 2002- 500626, patent literature and 2, published Japanese translations of PCT international publication for patent application 2002- 540129).

However, in order to demonstrate the preventing effect of the caries with the CPP - ACP in the oral cavity, it is necessary to keep the component of the CPP - ACP for a long time. For example, in the case of the chewing gum blended with the CPP - ACP, it is necessary to chew simultaneously two grains of it, i.e., 3 grams, for 20 minutes and four times per day during two weeks as a standard (refer to non-patent literature

3, Shen P et al. "Remineralization of enamel subsurface lesions by sugar-free chewing gum containing casein phophopeptide - amorphous calcium phosphate." J Dent Res 2001 Dec : 80(12) : 2066-70).

It is difficult to apply such action many times per day as mentioned above when considering the general lifestyle. So, in order to demonstrate the prevention effect of the caries with the CPP - ACP even when applying 1 time per day, it has been examined to apply the composition for caring the oral cavity like a paste or a cream, which contains the CPP - ACP, on the tooth.

However, as for the conventional composition for caring the oral cavity like the paste or the cream, which contains the CPP - ACP, there is a problem that the state of the composition becomes uneven since the composition is gelled or lumps are generated at the time of preserving for a long time.

Then, the present invention has the object to provide the composition for the caries prevention, which has the effects for efficiently suppressing the demineralization and promoting the remineralization, and an excellent stability in keeping for a long time.

Summary of the Invention

The present inventors made wholeheartedly investigations in order to solve the above problems,

and as the result, they found out the method to obtain the excellent composition for the caries prevention. That is, in the composition comprising (a) the casein phosphopeptide - amorphous calcium phosphate complex (CPP - ACP) and / or the casein phosphopeptide - amorphous calcium fluoride phosphate complex (CPP - ACFP), (b) a sodium carboxymethylcellulose, (c) a viscosity regulator, and (d) water, when the sodium carboxymethylcellulose having a specific etherification degree was used, the composition for the caries prevention, which has the effects for efficiently suppressing the demineralization and promoting the remineralization, and the excellent stability in keeping for a long time, was obtained. Then, the present invention was completed.

In a first aspect of the present invention, composition for the oral cavity to prevent the caries comprises (a) 1 to 30 % by weight of the casein phosphopeptide - amorphous calcium phosphate complex (CPP - ACP) and / or the casein phosphopeptide - amorphous calcium fluoride phosphate complex (CPP - ACFP), (b) 0.01 to 10 % by weight of the sodium carboxymethylcellulose, having the etherification degree of 0.7 to 1.0, (c) 0.5 to 40 % by weight of the viscosity regulator, and (d) a residual amount of

water. This composition is used by coating on the tooth. In a second aspect of the present invention, a composition for oral cavity to prevent a caries comprises (a) 1 to 30 % by weight of the casein phosphopeptide-amorphous calcium phosphate complex (CCP-ACP) and/or the casein phosphopeptide-amorphous calcium fluoride phosphate complex (CCP-ACFP), (b) 0.01 to 10 % by weight of the sodium carboxymethylcellulose having the etherification degree of 0.7 to 1.0, (c) 0.5 to 40 % by weight of the viscosity regulator, (e) 0.01 to 5.0 % by weight of the fluoride compound, and (d) a residual amount of water, and being used by applying on a tooth. In a third aspect of the present invention, the fluoride compound is at least one selected from the group consisting of sodium fluoride, stannous fluoride, sodium monofluoro phosphate in the composition for oral cavity to prevent a caries according to the second aspect of the present invention.

Hereinafter, the composition for the caries prevention of the present invention will be explained.

(a) The casein phosphopeptide - amorphous calcium phosphate complex (CPP - ACP) and / or the casein phosphopeptide - amorphous calcium fluoride phosphate complex (CPP - ACFP) are not especially limited, if

it is approved as foods or in dentistry. For example, the material prepared by the method of mixing calcium, an inorganic phosphoric acid, and fluoride if necessary with phosphopeptide, filtrating the mixed material, and drying, is preferably used in respect of the composition and crystallinity (refer to published Japanese translation of PTC international publication for patent application 2002-500626).

At this time, the blending amount of the casein phosphopeptide - amorphous calcium phosphate complex (CPP-ACP) and / or the casein phosphopeptide - amorphous calcium fluoride phosphate complex (CPP - ACFP) (a) is 1 to 30 % by weight of the whole composition, preferably 1 to 10 % by weight especially. If said amount is less than 1 % by weight, the supplying of calcium and phosphorus is not sufficient, so that the prevention effect of the caries can not be obtained. If said amount exceeds 30 % by weight, the viscosity of the composition becomes too high.

The etherification degree of the sodium carboxymethylcellulose (b), which is blended to obtain stability in keeping for a long time, is 0.7 to 1.0, preferably 0.85 to 0.95 especially. Because, if the etherification degree is less than 0.7, the blending effect can not be obtained, and if said amount exceeds

1.0, the sodium carboxymethylcellulose is easily influenced by calcium existing in the CPP - ACP and / or the CPP - ACFP, so that the preservation property becomes to be insufficient, since an insoluble precipitate is generated or said sodium carboxymethylcellulose is gelled.

The blending amount of the sodium carboxymethylcellulose having the etherification degree of 0.7 to 1.0 is 0.01 to 10 % by weight of the whole composition, preferably 1 to 5 % by weight especially. If said amount is less than 0.01 % by weight, the viscosity of the composition is low and it easily flows with saliva at the time of the applying on the tooth. Therefore, the prevention effect of the caries can not be obtained. If said amount exceeds 10 % by weight, the viscosity of the composition is high and it can not easily spread at the time of the applying on the tooth, and the sense of use is also bad.

In the composition for the caries prevention of the present invention, it is necessary to use (c) the viscosity regulator, in order to use the composition by applying on the tooth and to obtain the prevention effect of the caries by (a) the casein phosphopeptide - amorphous calcium phosphate complex (CPP-ACP) and / or the casein phosphopeptide - amorphous calcium

fluoride phosphate complex (CPP - ACFP) being stayed in the oral cavity. As for (c) the viscosity regulator, for example, a natural material, such as gum guaiac, carob bean gum, Tara gum, tamarind seed gum, gum arabic, tragacanth gum, karaya gum, carrageenan, xanthan gum, gellan gum, curdlan, chitin, chitosan or chitosamine, an organic synthetic material, such as glycerin, propylene glycol, sodium alginate, propylene glycol ester alginate, sodium starch glycolate, sodium starch phosphate ester, sodium polyacrylate or polyvinyl pyrrolidone, or an inorganic synthetic material, such as calcium carbonate, calcium silicate, a silica fine powder, amorphous hydrous silica or hydrophobic silica, can be used.

When the using method of directly applying on the tooth is considered, the viscosity of the composition is suitably 1,000 to 500,000 cP at 25 degree C, preferably 20,000 to 200,000 cP. Therefore, the blending amount of (c) the viscosity regulator is 0.5 to 40 % by weight of the whole composition, preferably 1 to 10 % by weight especially.

The present invention is of the composition for the oral cavity to prevent the caries, further comprising (e) 0.01 to 5.0 % by weight of a fluoride complex, in order to obtain more caries prevention.

If said amount is less than 0.05 % by weight, the acceleration of remineralization is low and if said amount exceeds 5.0 % by weight, the safety to human body becomes low. Preferable amount is 0.05 to 2.0 % by weight. The fluoride complex is preferably used at least one selected from the group consisting of sodium fluoride, stannous fluoride, sodium monofluoro phosphate.

Since the composition for the caries prevention of the present invention is directly coated on the tooth, pH is adjusted in the range of 5.5 to 9.5 preferably. Although the method for keeping said range is not limited especially, for example, an aqueous solution of phosphate, which is one of the constitution components of the CPP - ACP and the CPP - ACFP, or phosphate salt is added to adjust the pH preferably.

In addition, in the composition for the caries prevention of the present invention, a sweetener, a colorant, a preservative, an antifungal agent, or a flavor etc., which are used to the general composition for the caries prevention, can be suitably blended.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Hereinafter, the present invention will be explained concretely with the examples and comparison examples, but is not limited to the following examples.

The blends of the compositions used in the examples and the comparison examples were collectively shown in Table 1 and 2, and the pH and the viscosity at 25 degree C of these compositions were collectively shown in Table 3 and 4.

[Evaluation of Keeping Stability]

The compositions for the oral cavity to prevent the caries, which were blended with the composition shown in Table 1 and 2, were kept under the conditions at 60 degree C for 1 week, and then, said compositions were observed. These results were collectively shown in Table 3 and 4.

[Evaluation of Remineralization Effect]

The evaluation was carried out by using a bovine tooth in vitro, according to the method described in Reynolds EC "Remineralization of enamel subsurface lesions by casein phosphopeptide-stabilized calcium phosphate solutions." J. Dent. Res. 1997 Sep; 76(9): 1587-95.

(1) The bovine tooth was embedded with a dental resin to make an enamel testing surface having the length of 7 mm and the width of 1 mm. Said enamel testing surface was made into an enamel block.

(2) The enamel block was dipped in 40 ml of the demineralization liquid, which was blended with

following materials, under an atmosphere at 37 degree C for 4 days, to make an artificial caries.

Blending of the demineralization liquid (pH 4.8)

lactic acid : 0.1 mol / L

calcium chloride : 1.5m.mol/ L

potassium dihydrogen phosphate : 0.9m.mol / L

sodium carboxymethylcellulose (cellogen HE-1500F, made by Daiichi Kogyo Seiyaku Co., Ltd.) : 1% by weight

(3) An enamel varnish was coated on about a half of the enamel block surface, where the artificial caries was made, for not generating the remineralization, and said enamel block was dipped in a slurry liquid, which was obtained by diluting the compositions of Examples 1~20 and Comparison example 1~4 with distilled water 5 times, for 10 days, to carry out the remineralization treatment. At the example 18, 19 and 20, a phosphatase (Phosphatase, acid derived from wheat, made by SIGMA Chem. Co., Ltd.) is added 0.025 units/mL to said slurry liquid.

(4) A thin sliced piece having the thickness of about 100 μ m was made from the enamel block.

(5) A X-ray picture of the thin sliced piece of (4) was photographed, and mineral qualities of demineralized and remineralized parts were calculated

with the distances from the surface and the luminances at said parts, by using an image analyzer. Then, a remineralization ratio was obtained. If the value of said ratio was larger, such part was more remineralized. These results were collectively shown in Table 3 and 4.

[Evaluation of Staying Ability in Oral Cavity]

The composition for the caries prevention blended with the composition shown in Table 1 and 2 is coated on the whole surface of the tooth by a tooth brush. After one hour, the calcium ion in the saliva was measured to evaluate the staying ability. These results were shown in Table 3 and 4.

[Table 1]

	Component	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Example 8	Example 9	Example 10
(a)	CPP - ACP	10.00		10.00	5.00	20.00	10.00	5.00	10.00	10.00	10.00
	CPP - ACFP		10.00		5.00						
(b)	Cellogen F - SA (Etherification Degree is 0.70 to 0.80)			3.50			1.25		0.50		1.00
	Cellogen F - AG (Etherification Degree is 0.85 to 0.95)	3.00	3.00		3.00	2.00	1.25	2.00		2.50	1.00
	Cellogen F - 1220B (Etherification Degree is 1.15 to 1.35)										
	Cellogen F - 90F (Etherification Degree is 1.20 to 1.30)										
(c)	Guam Guaiac							0.50			
	Xanthan Gum								1.00		
	Tamarind Gum									0.50	
	Rapport Gum										0.30
	Glycerin	20.00	20.00	15.00	20.00	20.00	10.00	30.00	20.00	15.00	20.00
	Propylene Glycol	2.00	2.00	10.00	2.00	3.00	5.00	0.50	2.00	1.00	2.00
	Polyvinyl Pyrrolidone						1.00				
	Aerosil A200	2.00	2.00	2.00	2.00	1.50	2.50	2.00	2.00	2.00	2.00
	Titanium Dioxide	1.50	1.50	1.50	2.00	2.50	2.00	2.50	2.00	2.00	2.00
	Xylitol	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Sorbitol	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	p-Hydroxy Benzoic Ester	0.10	0.10	0.10	0.10	0.05	0.10	0.10	0.10	0.10	0.10
additive	Spice	0.20	0.20	0.20	0.20	0.10	0.20	0.20	0.20	0.20	0.20
	Phosphate	0.30	0.30	0.30	0.30	0.40	0.15	0.30	0.30	0.30	0.30
	Water	59.80	59.80	56.30	59.30	49.35	65.45	55.80	60.80	65.30	60.00

(Note) Cellogen F-SA, Cellogen F-AG, Cellogen F-1220B and Cellogen F-90F are sodium carboxymethylcellulose produced by Daiichi Kogyo Seiyaku Co., Ltd.
Aerosil A200 is silica fine powder produced by Nippon Aerosil Co., Ltd.

[Table 2]

	Component	Example 11	Example 12	Example 13	Example 14	Example 15	Example 16	Example 17	Example 18	Example 19	Example 20	Comparison Example 1	Comparison Example 2	Comparison Example 3	Comparison Example 4
(a)	GPP - AGP	10.00		10.00	5.00	20.00	10.00	5.00	10.00	10.00	10.00		10.00	10.00	10.00
	GPP - ACFP		10.00		5.00										
(b)	Cellogen F - SA (Etherification Degree is 0.70 to 0.80)			3.50			1.25		0.50		1.00				
	Cellogen F - AG (Etherification Degree is 0.85 to 0.95)	3.00	3.00		3.00	2.00	1.25	2.00		2.50	1.00	3.50			
	Cellogen F - 1220B (Etherification Degree is 1.15 to 1.35)													1.50	
	Cellogen F - 90F (Etherification Degree is 1.20 to 1.30)												3.00		
	Guam Guaiac							0.50							
(c)	Xanthan Gum								1.00						
	Tamarind Gum									0.50					
	Rapport Gum										0.30				
	Glycerin	20.00	20.00	15.00	20.00	20.00	10.00	30.00	20.00	15.00	20.00	20.00	20.00	20.00	20.00
	Propylene Glycol	2.00	2.00	10.00	2.00	3.00	5.00	0.50	2.00	1.00	2.00	2.00	2.00	2.00	2.00
	Polyvinyl Pyrrolidone						1.00								
	Aerosil A200	2.00	2.00	2.00	2.00	1.50	2.50	2.00	2.00	2.00	2.00	2.00	2.00	2.00	
(e)	Titanium Dioxide	1.50	1.50	1.50	2.00	2.50	2.00	2.50	2.00	2.00	2.00	1.50	1.50	1.50	
	Sodium fluoride	0.15			1.00	0.20	0.20								0.20
	Sodium fluoride		2.00	0.02				0.05						0.10	
	Sodium fluoride								0.30	0.03	3.50		0.10		
additive	Xylitol	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	10.00
	Sorbitol	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
	Sodium Fluoride					0.20	0.20								0.20
	p-Hydroxy														
	Benzoic Ester	0.10	0.10	0.10	0.10	0.05	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.05
	Spice	0.20	0.20	0.20	0.20	0.10	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.10
(d)	Phosphate	0.30	0.30	0.30	0.30	0.40	0.15	0.30	0.30	0.30	0.30		0.30	0.30	0.30
	Water	59.65	57.80	56.28	58.30	49.15	65.25	55.75	60.50	65.27	56.50	69.60	59.70	61.20	57.35

(Note) Cellogen F-SA, Cellogen F-AG, Cellogen F-1220B and Cellogen F-90F are sodium carboxymethylcellulose produced by Daichi Kogyo Seiyaku Co., Ltd.

Aerosil A200 is silica fine powder produced by Nippon Aerosil Co., Ltd.

[Table 3]

	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Example 8	Example 9	Example 10
pH	7.8	7.8	7.8	7.8	7.5	7.8	7.8	7.8	7.8	7.8
Viscosity [cp / 25 degree C]	70,000	5,000	58,000	68,000	71,000	75,000	60,000	52,000	85,000	66,000
Keeping Stability [Keeping at 60 degree C for 1 week]	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Remineralization Ratio [%]	35.2	49.8	30.5	39.3	54.3	43.3	29.8	33.9	31.8	39.4
Staying Ability in Oral Cavity [μ g / mL]	92.5	90.1	89.7	91.2	115.4	98.3	78.2	84.5	93.3	96.7

[Table 4]

	Example 11	Example 12	Example 13	Example 14	Example 15	Example 16	Example 17	Example 18	Example 19	Example 20	Comparison Example 1	Comparison Example 2	Comparison Example 3	Comparison Example 4
pH	7.8	7.8	7.8	7.8	7.5	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
Viscosity [cp / 25 degree C]	70,000	5,000	58,000	68,000	71,000	75,000	60,000	52,000	85,000	66,000	60,000	48,000	71,000	920
Keeping Stability [Keeping at 60 degree C for 1 week]	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Bad (Gelled)	Bad (Gelled)	Good
Remineralization Ratio [%]	39.5	50.3	39.4	44.2	55.8	48.3	31.9	38.1	34.9	41.3	1.4	29.9	33.5	30.8
Staying Ability in Oral Cavity [$\mu\text{g} / \text{mL}$]	92.3	90.5	90.1	89.4	115.2	98.2	79.3	85.2	93.5	96.3	57.2	82.1	91.4	86.3

Clearly from Table 3, it was identified that the composition for the caries prevention being excellent in the caries prevention and the stability in keeping for a long time, could be obtained, by selecting the specific sodium carboxymethylcellulose having the specific etherification degree and blending said sodium carboxymethylcellulose with the composition for the caries prevention containing the CPP - ACP and / or CPP-ACFP.

The composition for the caries prevention of the present invention contains the CPP - ACP and / or CPP-ACFP and is blended with sodium carboxymethylcellulose having the etherification degree of 0.7 to 1.0, so that it has promoting effect of the remineralization and excellent stability in keeping for a long time. Therefore, said composition has the great value for contributing to dental medicine.

Clearly from Table 4, the compositions have further containing the fluoride complex, it is excellent in the caries prevention as compared with the compositions which has no fluoride complex in example 1 to 10.

What is claimed is,

1. A composition for oral cavity to prevent a caries, comprising (a) 1 to 30 % by weight of the casein phosphopeptide - amorphous calcium phosphate complex (CPP - ACP) and / or the casein phosphopeptide - amorphous calcium fluoride phosphate complex (CPP - ACFP), (b) 0.01 to 10 % by weight of the sodium carboxymethylcellulose having the etherification degree of 0.7 to 1.0, (c) 0.5 to 40 % by weight of the viscosity regulator, and (d) a residual amount of water, and being used by applying on a tooth.

2. A composition for oral cavity to prevent a caries, comprising (a) 1 to 30 % by weight of the casein phosphopeptide-amorphous calcium phosphate complex (CCP-ACP) and/or the casein phosphopeptide-amorphous calcium fluoride phosphate complex (CCP-ACFP), (b) 0.01 to 10 % by weight of the sodium carboxymethylcellulose having the etherification degree of 0.7 to 1.0, (c) 0.5 to 40 % by weight of the viscosity regulator, (e) 0.01 to 5.0 % by weight of the fluoride compound, and (d) a residual amount of water, and being used by applying on a tooth.

3. A composition for oral cavity to prevent a caries as claimed 2, wherein the fluoride compound is at least one selected from the group consisting of

sodium fluoride, stannous fluoride, sodium monofluoro
phosphate.