≪Cosmetic Raw Materials≫

“Amphiphilic poly-glucosamine(chitosan) derivatives” Emine®
[Moisturizer, Water-holding, Emollient, Barrier film etc.]

Amphiphilic poly-glucosamine (Chitosan) derivatives [Emine®] are the compounds prepared by bonding long fatty acids to mucopolysaccharide and then introducing strong water-soluble groups such as quaternary ammonium salt, sulfonic acid salt and succinyl type. Various fatty acids and their mixtures were transformed to anhydrides and bonded to poly-glucosamine under mild conditions by amide bondage, and water-soluble groups were introduced under strong alkaline conditions mainly to the hydroxyl group at 6-position of the sugar group without the decomposition of them. These compounds are amphiphilic because they have hydrophobic long alkyl chains and water-soluble group as well as hydrophilic glucosamine residue. Therefore, they have both properties of oils (humidity retaining, emollient) and moisturizer, from the viewpoint of cosmetic raw materials. Such type of amphiphilic polymer prepared by the modification of natural polymers has never commercially presented, because the introduction of above-mentioned groups to the sugar residue is usually difficult. Emine® of cosmetic raw material is various properties effective for skin and hair cosmetics such as water-holding, emollient, barrier film, damage repair and so on.

”Emine® ” Cosmetic Raw Material (Liquid image)

tsk labo

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Emine® Series

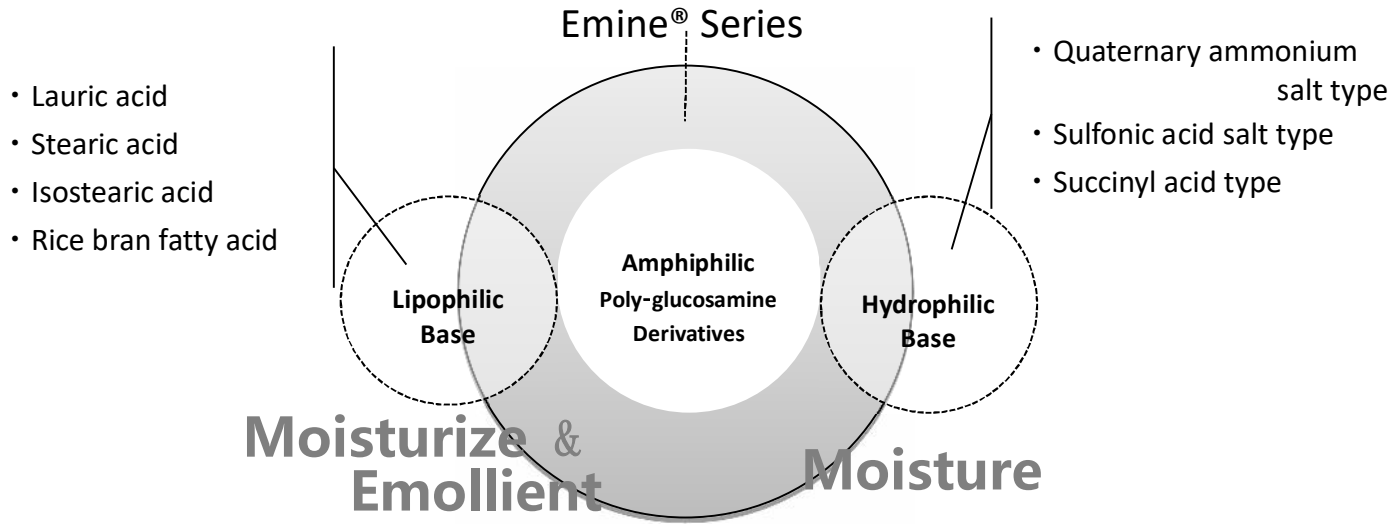
Cosmetic Raw Materials
"Amphiphilic Poly-glucosamine Derivatives"

◆ Introduction

Application of oil to the skin or hair might be the most popular way to protect them from water evaporation and dry damage. To retain sufficient moisture in skin, conventionally there were only two choices: either applying oil directly to skin with sticky feel, or using skin milk or lotion with surfactant-emulsified oil. Now there is a better alternative—the Emine® Series.

◆ Features

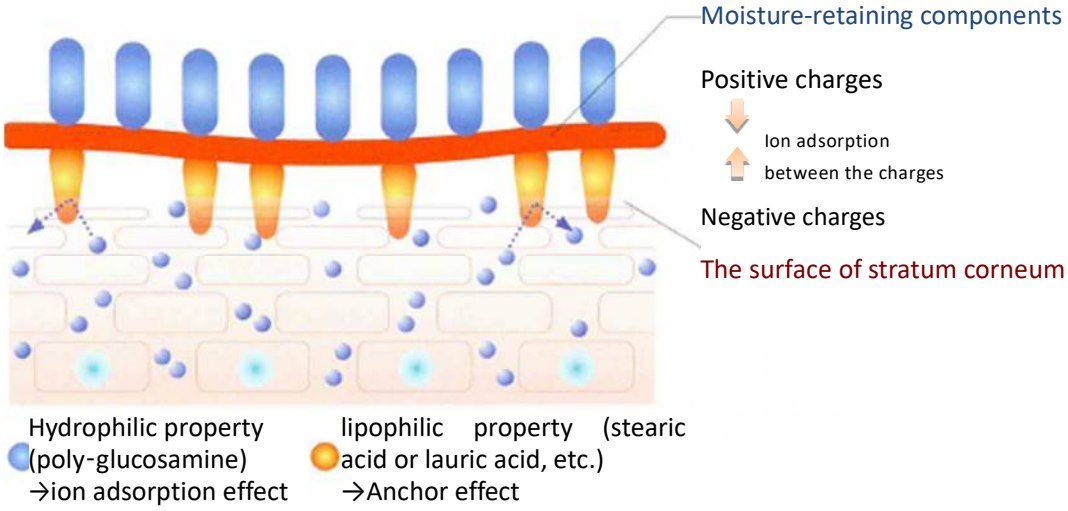
- ✧ It contains a whole new ingredient (Japan patent no. 4394483), which combining poly-glucosamine (hydrophilic property) with fatty acid (lipophilic property) such as stearic acid or lauric acid, that making it skin-friendly and effective on water retention, moisturizing and emollient.
- ✧ The poly-glucosamine has an antibacterial effect, moisture retention effect and ion adsorption effect; and by the help from lipophilic property (hydrophobic group) of fatty acid, an invisible long-lasting high molecule veil is formed on the surface of skin or hair to protect the skin or hair from dry damage.
- ✧ The high molecule veil will capture the water evaporating from stratum corneum and keep it on the surface of skin or hair, moisturizing and softening the stratum corneum (emollient effect).
- ✧ Emine® Series is capable to emulsify oil ingredients such as squalene, argan oil, oil-soluble vitamins directly without surfactants.
- ✧ It is broadly adapted to products with different pH levels due to its various types of options: quaternary ammonium salt type, sulfonic acid type, succinyl acid type.
- ✧ Recommended use: Skin care products (facial wash, body soap, UV care, lotion, cream, etc.), various hair care products, bath additive, etc.



◆ Functional comparison between Emine® Series and Hyaluronic Acid

		Emine® Series	Hyaluronic Acid
Hydrophilic property		◎	○
Lipophilic property		◎	×
Emollient effect		◎	×
Pharmacological effects	Antibacterial effect	◎	×
	Biocompatibility	◎	◎
	Coating	◎	◎

◆ A Long-Lasting Moisture-Retaining Veil on the Skin



- **<u>The ion adsorption effect</u>:** The surface of our skin or hair is negatively charged; therefore, the poly-glucosamine, which is positively charged, will be adsorbed on the skin surface and forming a protection like a veil on it.
- **<u>Anchor effect:</u>** Emine® Series adhere firmly to the surface of the stratum corneum, which is hydrophobic, and the fatty acids, which are also hydrophobic, secure it to the skin surface like anchors. This is how Emine® Series attaches itself securely on and effectively retains moisture in the skin.

◆ Product Types

There are two options of the products: 1% (standard) and 2% (special order) aqueous solution with BG. The aqueous solution made it easier to dissolve the other ingredients.

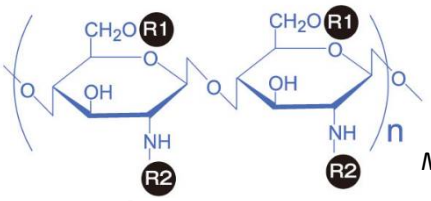
1% Sol. (standard) ※Ending with "BG(1)"		
Displayed name as cosmetic ingredients	INCI Name	Concentration
Labeling name of each product		1.0%
BG	Butylene Glycol	15.0%
Water	Water	84.0%

2% Sol. (special) ※Ending with "BG(2)"		
Displayed name as cosmetic ingredients	INCI Name	Concentration
Labeling name of each product		2.0%
BG	Butylene Glycol	30.0%
Water	Water	68.0%

[MATERIAL LINE-UP ①]

Emine® 6Q Series

Cationic Type



n≒2,500
Mw≒800,000

Quaternary Ammonium Salt Type of Poly-glucosamine Derivatives [Applicable pH levels: 1~14]

Product Name	Binding Amount of Fatty Acids	INCI Name	Applicable pH levels	Property
EXC-6QHC12(12.5)-BG(1)	Lauric acid (C12) [12.5%]	Chitosan Lauramide Hydroxypropyltrimonium Chloride	1~14	Light yellow viscous liquid
EXC-6QHC18(12.5)-BG(1)	Stearic acid (C18) [12.5%]	Chitosan Stearamide Hydroxypropyltrimonium Chloride	1~14	Light yellow and slightly cloudy viscous liquid
EXC-6QHISOC18(12.5)-BG(1)	Isostearic acid (ISOC18) [12.5%]	Chitosan Isostearamide Hydroxypropyltrimonium Chloride	1~14	Light yellow viscous liquid
EXC-6QHRBA(12.5)-BG(1)	Rice Bran fatty acid (RBA) [12.5%]	Chitosan Rice Branamide Hydroxypropyltrimonium Chloride	1~14	Light yellow viscous liquid

【Recommended Additional Products】 (Example)

◎Hair Rinse ◎Hair Conditioner ◎Hair Treatment

◎Pigment and Powder Dispersant ◎Color and Perm Agents …

≪Good Compatibility Ingredient≫ (Example)

・Cationized Cellulose ・Steryl Trimonium Chloride ・Cationic Surfactants

・Cationic Surfactants ・Polyoxyethylene Alkyl Ether ・Nonionic Polymers

・Nonionic Ingredients ・Cationic Ingredients …

≪Bad Compatibility Ingredient≫ (Example)

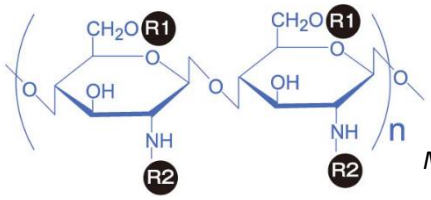
・Hyaluronic Acid ・Carbomer ・Xanthan Gum

・Sodium Laureth Sulfate ・Acrylic Polymer ・Anionic Ingredients …

[MATERIAL LINE-UP ②]

Emine® OSF Series

Anionic Type



n≒2,500
Mw≒800,000

Sulfonic Acid Salt Type of Poly-glucosamine Derivatives [Applicable pH levels: 1~14]

Product Name	Binding Amount of Fatty Acids	INCI Name	Applicable pH levels	Property
OSF-HPC12(12.5)-BG(1)	Lauric acid (C12) [12.5%]	Sodium Chitosan Lauramide Hydroxypropylsulfonate	1~14	Light yellow viscous liquid
OSF-HPC18(12.5)-BG(1)	Stearic acid (C18) [12.5%]	Sodium Chitosan Stearamide Hydroxypropylsulfonate	1~14	Light yellow and cloudy high-viscous liquid
OSF-HPISOC18(12.5)-BG(1)	Isostearic acid (ISOC18) [12.5%]	Sodium Chitosan Isostearamide Hydroxypropylsulfonate	1~14	Light yellow and slightly cloudy high-viscous liquid
OSF-HPRBA(12.5)-BG(1)	Rice Bran fatty acid (RBA) [12.5%]	Sodium Chitosan Rice Branamide Hydroxypropylsulfonate	1~14	Light yellow and slightly cloudy high-viscous liquid

【Recommended Additional Products】 (Example)

◎All Skin Care Products ◎Hair Shampoo ◎Leave-in Hair Care Products
◎UV Care Products …

≪Good Compatibility Ingredient≫ (Example)

・Hyaluronic Acid ・Carbomer ・Xanthan Gum
・Sodium Laureth Sulfate ・Acrylic Polymer ・Nonionic Polymers
・Nonionic Ingredients ・Anionic Ingredients …

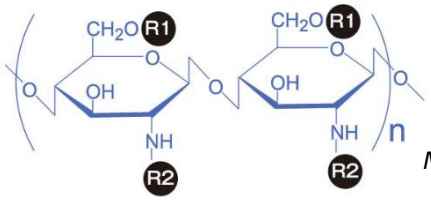
≪Bad Compatibility Ingredient≫ (Example)

・Cationized Cellulose ・Steryl Trimonium Chloride ・Cationic Surfactants
・Polyoxyethylene Alkyl Ether ・Cationic Ingredients …

[MATERIAL LINE-UP ③]

Emine® SUC Series

Anionic Type



n≒300
Mw≒100,000

Succinyl Type of Poly-glucosamine Derivatives [Applicable pH levels: 4~14]

R1 -H

R2 -H (or) $-COC_{11}H_{23}$ (Lauric acid) (or) $-CO-CH_2-CH_2-COOH$ (Succinic acid)

Product Name	Binding Amount of Fatty Acids	INCI Name	Applicable pH levels	Property
SUC-HPC12(12.5)-BG(1)	Lauric acid (C12) [12.5%]	Chitosan Lauramide Succinamide	4~14	Light yellow viscous liquid

※This product is special order made (Contact us)

【Recommended Additional Products】 (Example)

◎All Skin Care Products ◎Hair Shampoo ◎Leave-in Hair Care Products

◎UV Care Products …

≪Good Compatibility Ingredient≫ (Example)

・Hyaluronic Acid ・Carbomer ・Xanthan Gum

・Sodium Laureth Sulfate ・Acrylic Polymer ・Nonionic Polymers

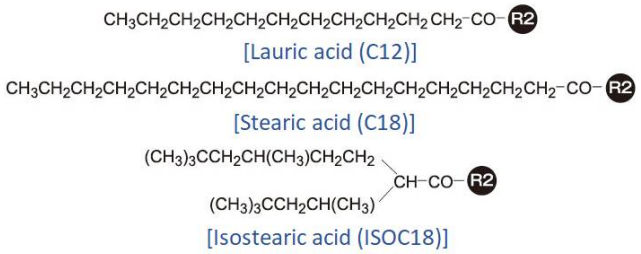
・Nonionic Ingredients ・Anionic Ingredients …

≪Bad Compatibility Ingredient≫ (Example)

・Cationized Cellulose ・Steryl Trimonium Chloride ・Cationic Surfactants

・Polyoxyethylene Alkyl Ether ・Cationic Ingredients …

[Structure of Fatty Acids]



[Lauric acid (C12)]

[Stearic acid (C18)]

[Isostearic acid (ISOC18)]

[Rice Bran Acid (RBA)]
- Palmitic acid 16%
- Stearic acid 2%
- Oleic acid 45%
- Linoleic acid 36%
- γ-Linoleic acid 1%

※All Materials Precautions for Use※

When adjusting pH or mixing with other active ingredients, so after dilution or after adding all ingredients. Do not add other active ingredients directly to each Emine® material.

◆ Evidence of the Safety, Biofilm Affinity, and Antibacterial Effect

DATA 01 : Skin Safety Test

A 3-dimensional cultured skin model was used to testify the safety of Emine® Series to the skin. As shown in Fig.1, the survival rate of skin cell of Emine® Series is the higher than the other surface-active agents, which are low molecule, even higher than distilled water. Fig. 2 is the result of the level of IL-1a production. Emine® Series has been proven its high safety to the skin through passing both the toxicity and irritation test.

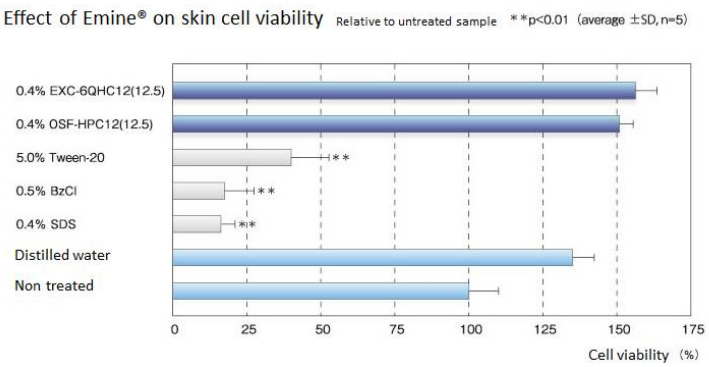


Fig1. Effect of Emine® on skin cell viability

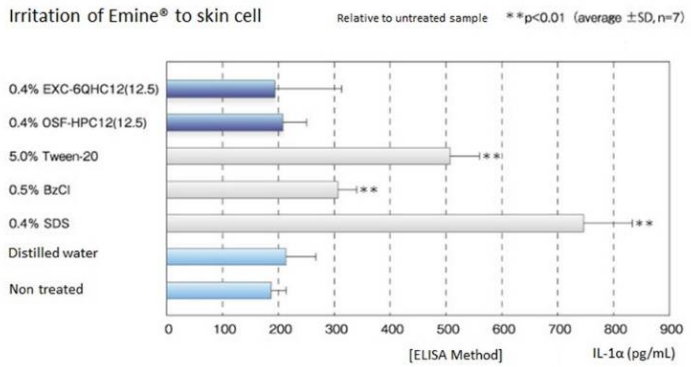
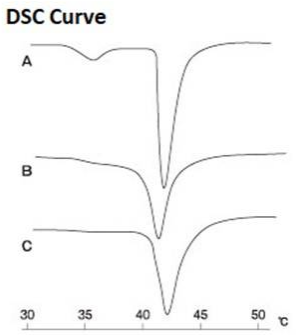


Fig 2. Irritation of Emine® to skin cell

DATA 02 : Biofilm-Friendly Effect (Anchor Effect)

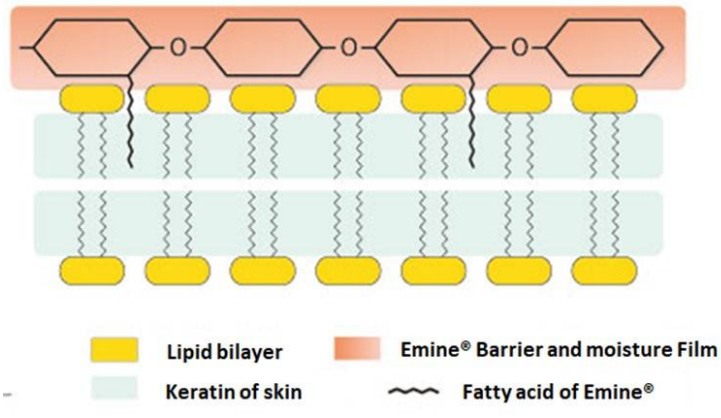
Emine® [0.4%EXC-6QHC12(12.5)] is mixed with biofilm model (the DPPC liposome) and then analyzed with DSC (Differential Scanning Calorimetry). The result shows that the phase transition temperature of the liposome solution increased with time due to the interaction between liposome and Emine®. It demonstrated the affinity of Emine® Series for the biofilm (anchor effect).



A: DPPC Liposome only

B: 1 day after mixing the DPPC liposome and the Emine®

C: 2 days after mixing the DPPC liposome and the Emine®

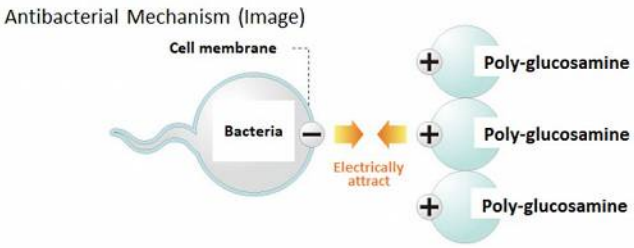


DATA 03 : Antibacterial Effect

Microorganisms (bacteria), which carry negative charges, adsorb to the positive-charged poly-glucosamine. The adsorption will prevent the bacteria from breeding, and keep the skin or hair away from the damage occurred in the process of destroying the cell directly, which is the strategy that the other antibacterial agents generally take.

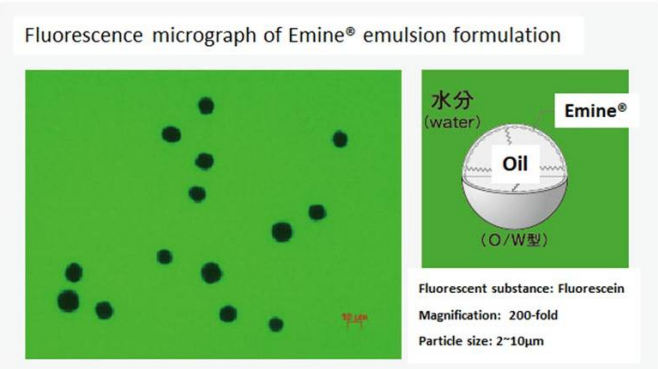
◆ The Minimum Concentration of Emine® [ex.EXC-6QHC12(12.5)]

	Bacterial name (scientific name)	Concentration (MIC)
Gram-negative bacteria	*Escherichia coli*	0.01%
	Pseudomonas aeruginosa	0.01%
Gram-positive bacteria	*Staphylococcus aureus*	0.03%
	Propionibacterium acnes	0.03%
	Bacillus subtilis	0.02%



DATA 04：Emulsification Ability

【The fluorescence micrograph of the Emine® emulsifying Formulation】



[Emine® emulsifying formulation(400bar,5pass)]
OSF-HPC12(12.5)-BG(1) 90.0%
Squalene 10.0%

As shown above, the emulsifying type of Emine® Series is oil-in-water(o/w) type. Emine® is finely dispersed in the emulsifier and capable to keep stable condition by wrapping oil inside itself.

DATA 05：Water Retention Effect

【Samples】

①1.0% OSF-HPC12(12.5)-BG(1) (stock solution)
②1.0% EXC-6QHC12(12.5)-BG(1) (stock solution)
③1.0% Hyaluronic Acid Na
④1.0% High molecular moisturizer–N (from the other company)

【Composition】

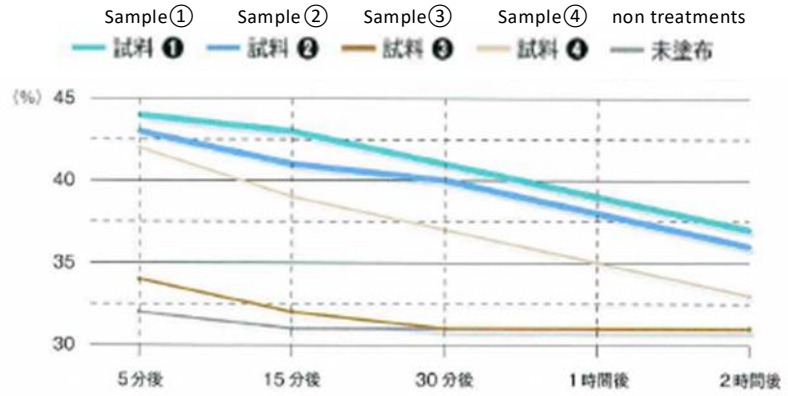
From each sample	1.0%
1.3-BG	15.0%
Pure Water	84.0%

【Method】BIA (Bioelectrical impedance analysis)

【Procedure】

The inner side of participants' (n=25) forearm were treated with the samples, washed up with water after 5 minutes, and wiped with a towel. The amount of water in the skin is measured after 5 minutes, 15 minutes, 30 minutes, 1 hour and 2 hours.

【Result】



(All participants are female, n=25, under 13.6℃ and 36.2% humidity)

The result indicated that ion-adsorption effect and anchor effect make Emine® Series capable to protect anions or cations from being washed off by water; while on the other hand, the result of hyaluronic acid Na decreased to the same level before the treatment. And regarding the high molecular moisturizer–N produced by the other company, its water retention effect declines notably by time. The experiment has proven the exceptional and long-lasting water retention effect of Emine® Series.

DATA 06：Improvement of rough skin

【Samples】

①1.0% OSF-HPC12(12.5)-BG(1) (stock solution)
②1.0% EXC-6QHC12(12.5)-BG(1) (stock solution)
③1.0% Hyaluronic Acid Na
④1.0% High molecular moisturizer–N (from the other company)

【Composition】

From each sample	1.0%
1.3-BG	15.0%
Pure water	84.0%

【Method】Questionnaire and digital microscope

【Procedure】

1. Questionnaire

25 females (age: 20~80) have engaged in the experiment. Participants applied the samples on the rough skin surface, which were artificially damaged at the previous day, of the inner side of their forearm. The experiment lasted for 3 days.

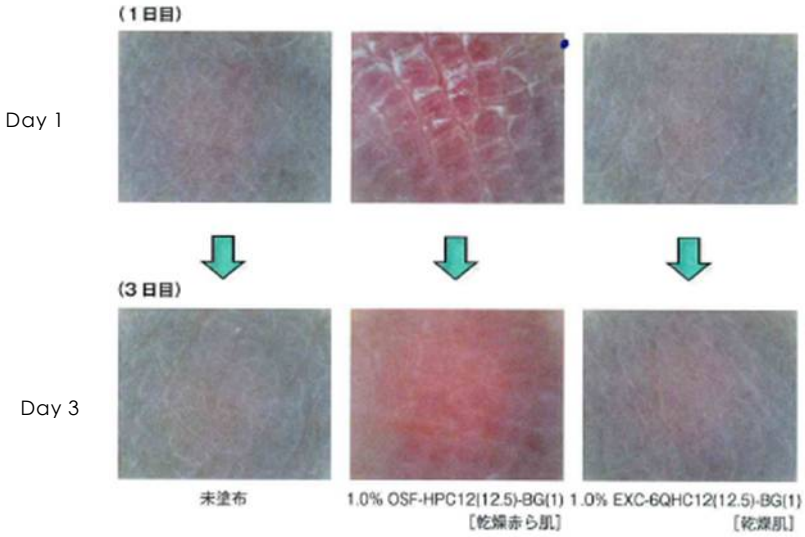
2. Digital microscope

After being damage by a 35% aqueous solution of sodium lauryl sulfate (SDS), the rough inner side of participants' forearm were treated with the samples, washed up with water after 5 minutes, and wiped with a towel.

【Results】

	Moist feeling Day 1	Moist feeling Day 2	Elastic skin Day 1	Elastic skin Day 2	Improvement of rough skin Day 1	Improvement of rough skin Day 2
Non treatments	12%	16%	12%	16%	8%	20%
Sample ①	68%	88%	76%	84%	44%	72%
Sample ②	60%	76%	56%	72%	40%	64%
Sample ③	20%	28%	28%	36%	12%	24%
Sample ④	52%	65%	48%	56%	36%	48%

【Pictures of digital microscope】



【Result】

The result from questionnaire shows that participants were feeling moist and elasticity of their skin, and the improvement of rough skin after applying Emine® Series. These results indicate that Emine® Series has an effect on improving skin condition while moisturizing it.

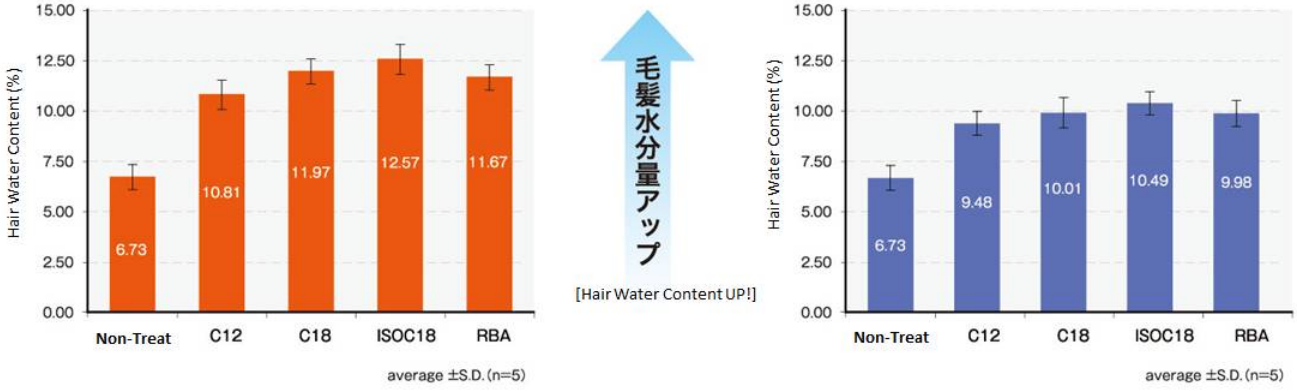
DATA 07：Hair Moisturizing Effect

【Procedure】

Prepare a 50-fold diluted (0.02% aqueous solution) 1% aqueous solution of each type of Emine series, and immerse each of the High-bleached hair. The hair was soaked at 40℃ for 10 minutes and then dried with a dryer. The water content of the dried hair was measured with an infrared moisture meter.

【Result】

The water content of hair treated with Emine 6Q and OSF series tended to increase about 1.4 to 1.8 times that of untreated hair. In particular, the 6Q series tended to have a higher moisturizing effect because of its strong ionic binding effect with hair.



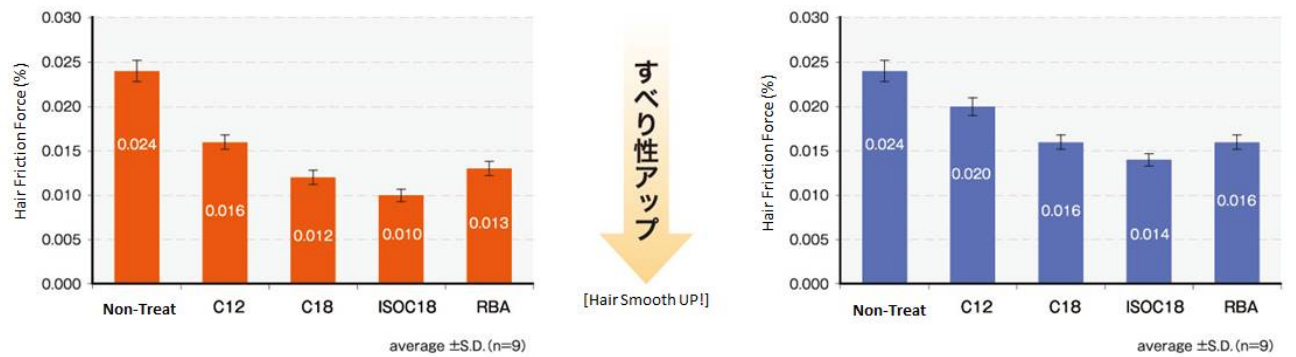
DATA 08：Hair Friction Reduction Effect

【Procedure】

Prepare a 50-fold diluted (0.02% aqueous solution) 1% aqueous solution of each type of Emine series, and immerse each of the High-bleached hair. The hair was soaked at 40℃ for 10 minutes and then dried with a dryer. The frictional force of dry hair was measured with a friction tester.

【Result】

The hair treated with Emine 6Q and OSF series showed a reduction in frictional force as a whole as compared with the untreated hair. From these results, it is expected that the Emine treated hair will be able to easily pass through the fingers and that the effect of suppressing static electricity can be expected. In particular, the 6Q series tended to have a higher suppressing static electricity because of its strong ionic binding effect with hair.



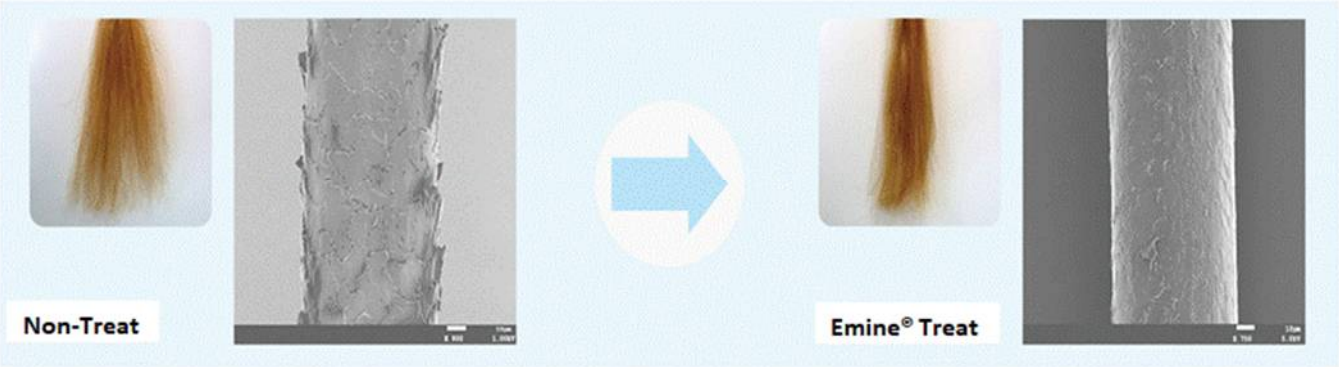
DATA 08 : Hair Barrier Film Effect

【Method】

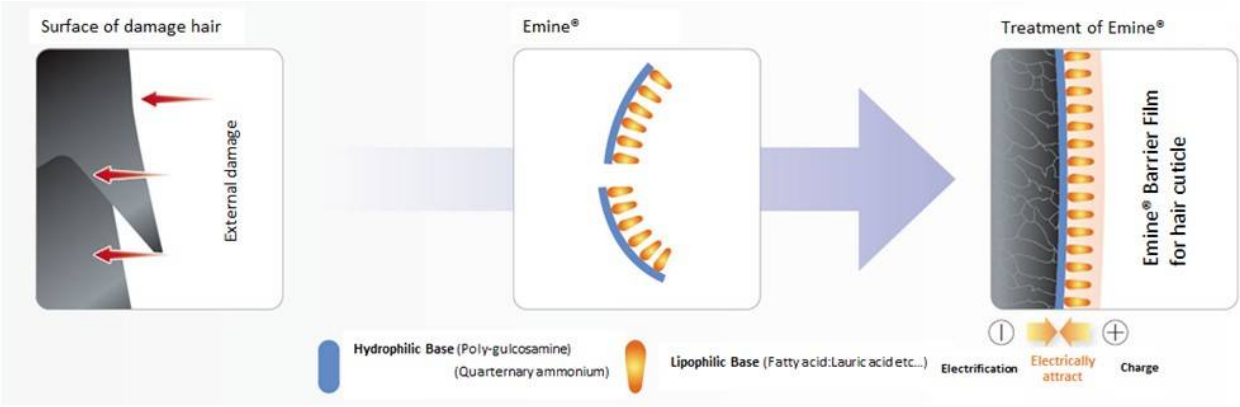
The High-bleached hair was soaked in a 50-fold diluted Emine® 1.0% EXC-6QHISOC18(12.5)-BG(1) solution at 40°C for 10 minutes. After drying the hair with a dryer, the state of the cuticle was observed by SEM(Scanning Electron Microscope).

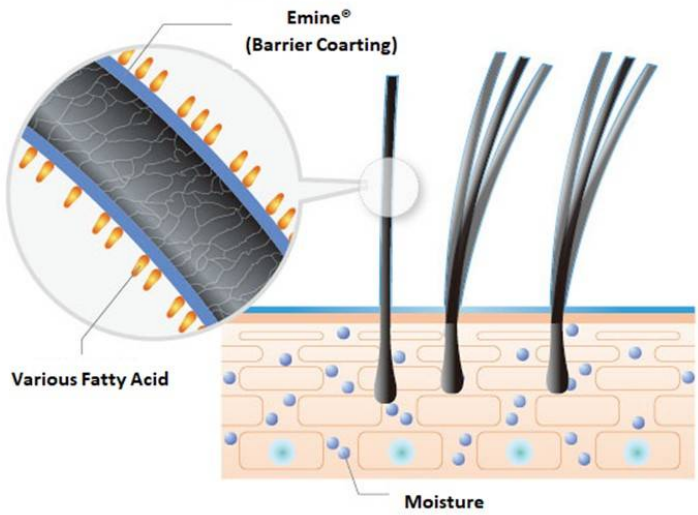
【Result】

Damaged hair treated with Emine® solution formed a barrier film on the surface of the hair cuticle. Hair coated with Emine® has smooth fingers and brush passages, giving a comfortable moisturizing feeling to the entire hair. In addition, it can be expected to protect hair from static electricity generated by friction such as brushing.



≪Image of Emine® adsorbed on hair cuticle≫





【Functional of Emine® for hair cosmetics】

◎Moisturizer
◎Water-holding
◎Barrier film and cuticle repair
◎Elasticity and pliability