PIUSERIA® AMC

Solves the problem (skin residue) of amino acid surfactants

◆Feature

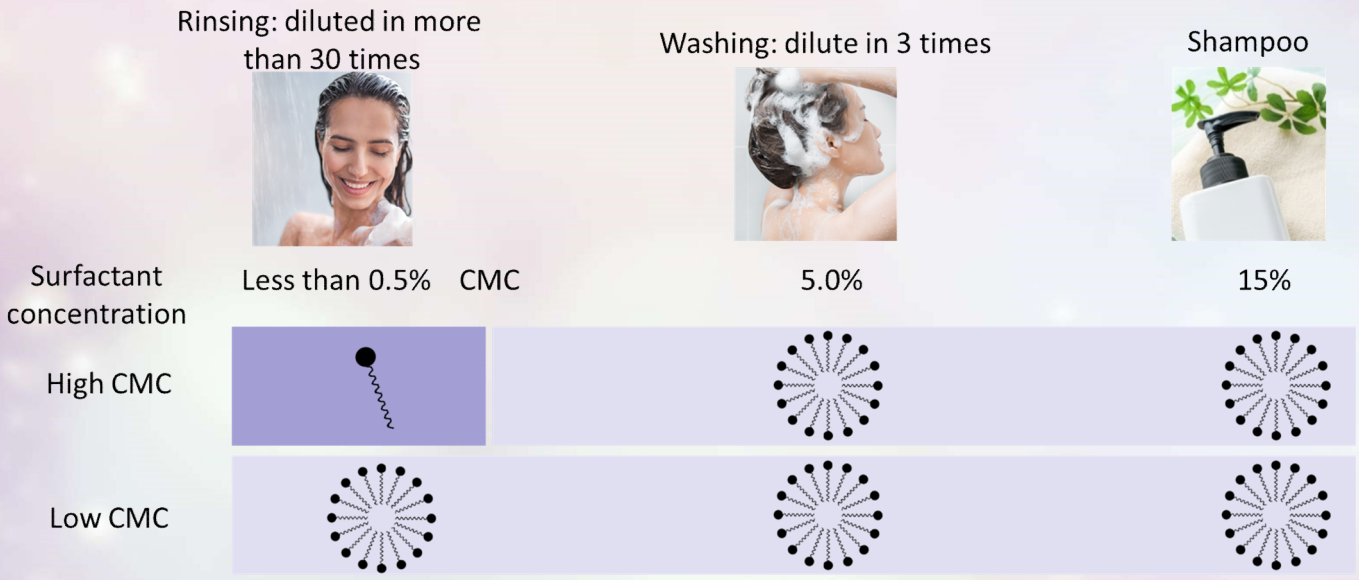
- Excellent washability enables to prevent itching and dandruff by reducing washing residue.
- Bacteriostatic effect against dandruff-causing bacteria
- Improve thickness and foam quality in amino acid-based shampoos
- Biodegradability
- RSPO certificate was acquired (Spring 2023)

◆Component

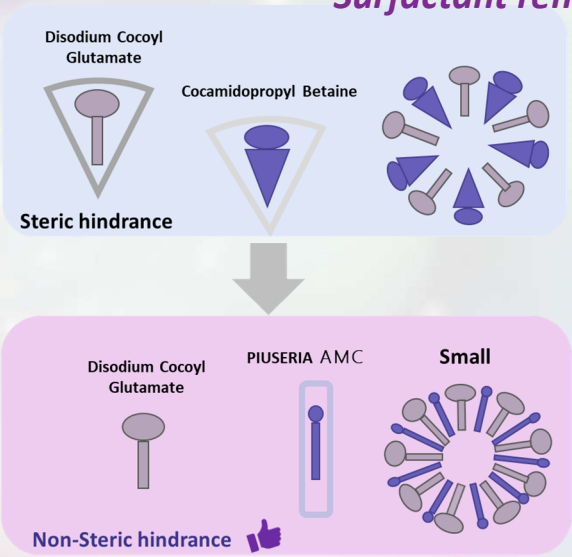
INCI Name	Evaporated residue	Appearance
Sodium Lauraminopropionate	29%	Pale yellow liquid

◆Benefits & our approach

Relationships between surfactant remaining on the skin and it's CMC



Surfactant remaining on the skin and CMC



Smaller steric repulsion

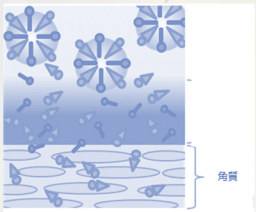
↓

Form aggregates easiliy with Amino-Acid based surfactant

↓

Reduce surfactant residue on skin

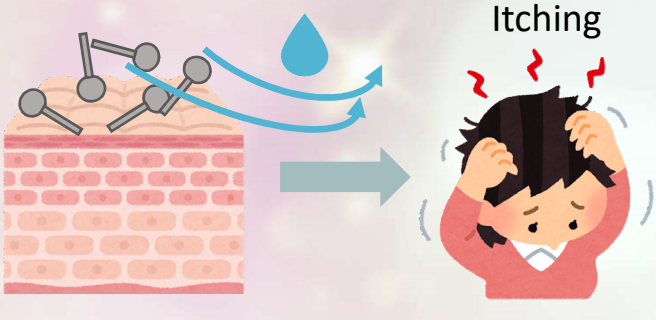
Less residue on skin	Small / Low / Fine / Less	Steric Repulsion / CMC / Foam / Free Surfactant	Large / High / Crude / More	More residue on skin



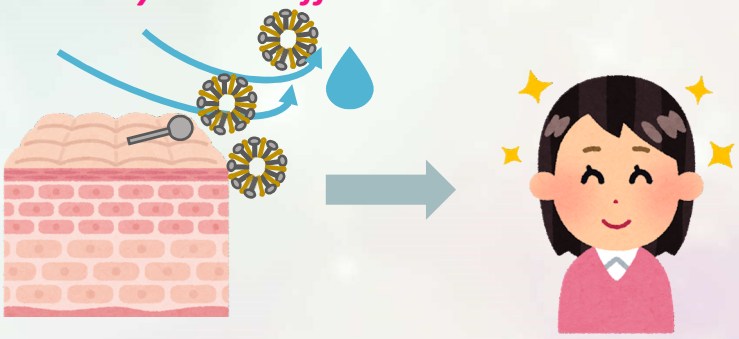
◆Mechanisms

*It is easier to rinse off, so hair can be washed with **less water!***

Amino-acid surfactants
➞*Easy to leave residue*

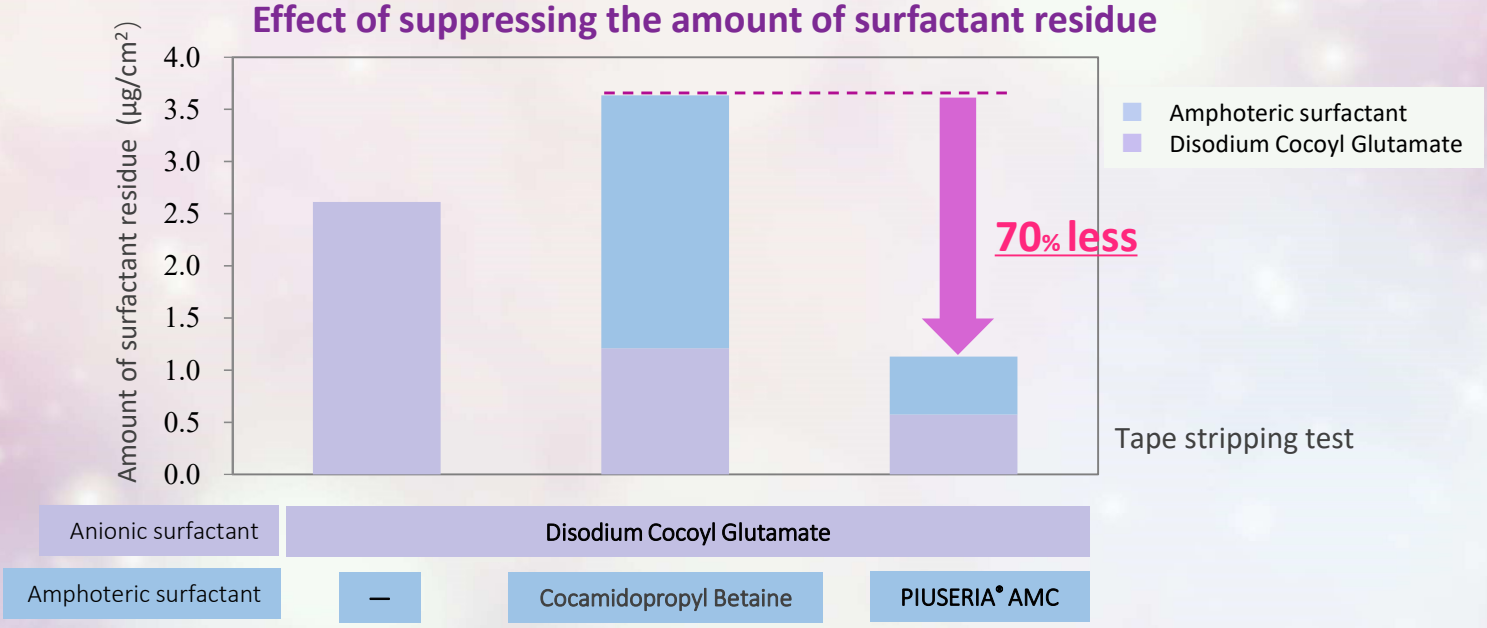


Amino-acid surfactants
+ Piuseria AMC
➞*Easy to rins-off*

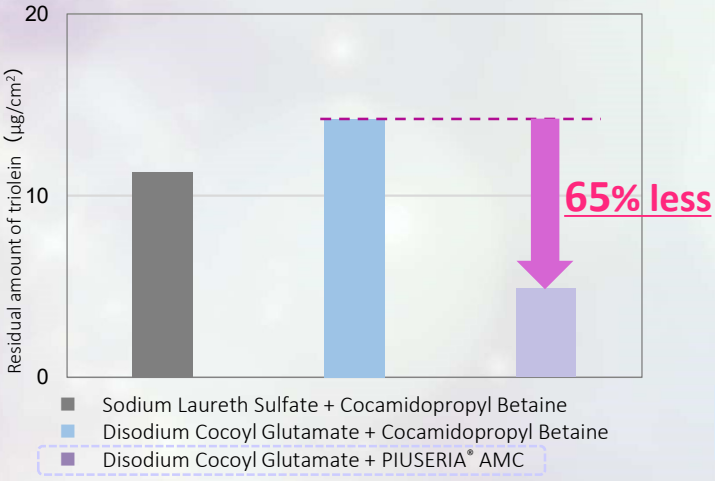


◆Application data(for hair)

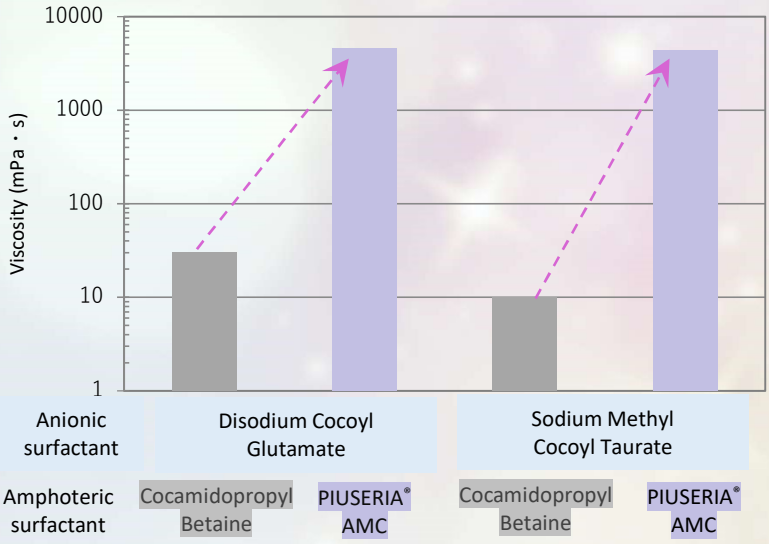
Effect of suppressing the amount of surfactant residue



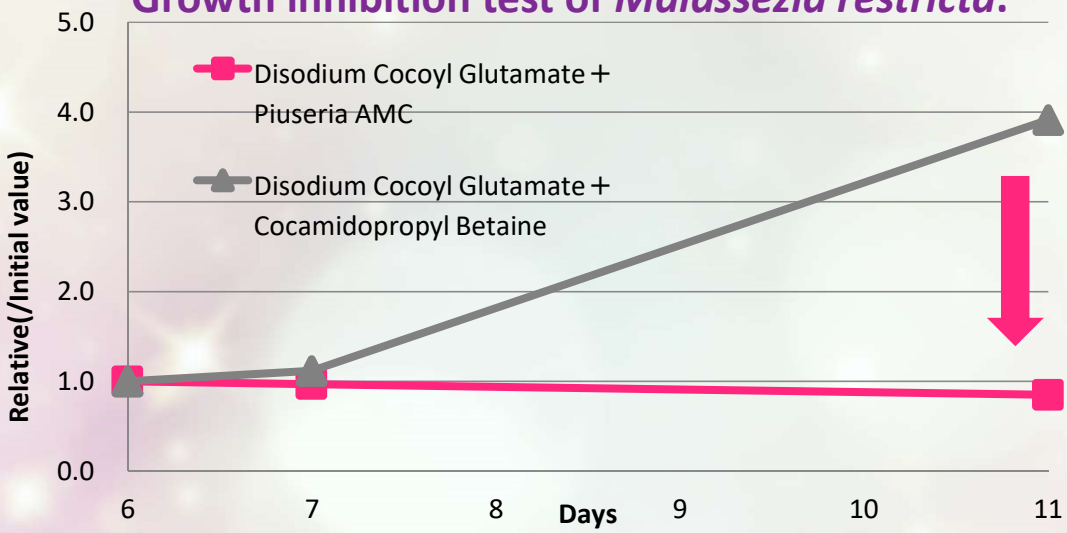
Enhance the cleaning ability of serum



Thickening cosmetic formulations

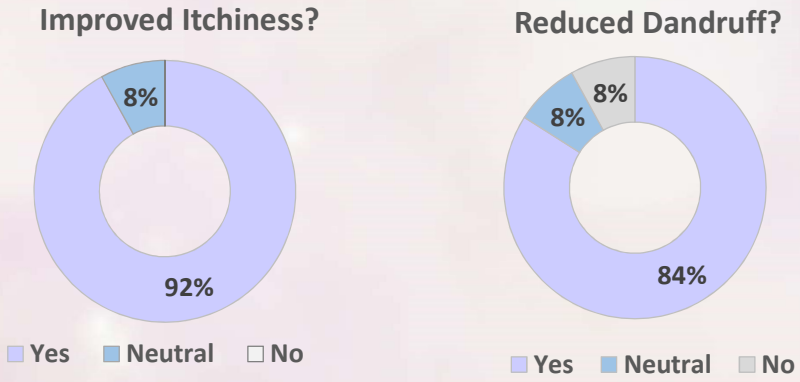


Growth inhibition test of *Malassezia restricta*.



Combined with PIUSERIA AMC, ***the growth of the bacteria is inhibited.***

The Results of Monitoring Test about Shampoo Formulation Using PIUSERIA® AMC



Implemented at SOUKEN Co., Ltd.
Questionnaire-based survey on differences before and after 2 weeks of continuous use
Subjects: 13 Japanese males and females aged from 20 to 61 years, who are generally interested in scalp dandruff and itching

◆Formula(shampoo)

This shampoo is gentle on the scalp and hair and has a rich foam.

	INCI Name	Sanyo's Product	wt%
	Water		41.00
A	Polyquaternium-22		1.25
	Polyquaternium-7		1.00
	Disodium EDTA		0.05
	Butylene Glycol		2.00
	Sodium Cocoyl Glutamate		20.70
	Sodium C14-16 Olefin Sulfonate		10.80
B	Cocamidopropyl Betaine	LEBON HC-30W	10.00
	Sodium Lauraminopropionate	**PIUSERIA AMC®**	**6.90**
	Cocamide Methyl MEA		3.00
	PEG-160 SorbitanTriisostearate		2.00
C	PEG-7 Glyceryl Cocoate		1.00
	Diisopropyl Sebacate		0.10
D	Iodopropynyl Butylcarbamate		0.20
	Hydroxypropyl Cyclodextrin, water		
	Citric Acid		(suitable)
	Sodium Hydroxide		(suitable)
		Total	100.00

<Method>
①A: After uniformly dissolving at room temperature, Heat to 80 ° C
②Heat B and C to 80°C.
③Add B gradually while stirring A.
④Add C to the mixture of A+B and stir.
⑤Add D to the mixture of A+B+C and stir.
⑥Cool mixture to 25°C.
⑦Adjust pH to 6 ± 0.1.
⑧Stir uniformly, then defoam.

◆Safety test

✓ Acute Eye Irritation test(OECD TG492): Safety
✓ 24-hour occlusion human patch test: Safety
✓ RIPT: Safety

◆Application data(for face & body)

PIUSERIA® AMC is expected to have bacteriostatic effects on *C. acnes and C. albicans*

Although Piuceria is not as strong as a fungicide, it can be added to the base formulation to reduce the amount of fungicide (supporting the antibacterial effect).

■MIC* of *C.acnes* and *C. albicance*

*MIC：minimum inhibitory concentration

C.acnes

(ppm)

Piuseri AMC	78-156
Methylparaben	2500
Isopropyl methylphenol	63-313
Phenoxyethanol	Non
Triclosan	1－4
Hinokitiol	31
Ethanol	≧500－1000

The using of Piuseria AMC in **a facial wash** can be expected to **prevent *C.acnes***.

C.albicance

(ppm)

Piuseria AMC	313-625
Methylparaben	1000
Propylparaben	250
Isopropyl methylphenol	500
Benzalkonium chloride	200
Salicylic acid	>1000
Dehydroacetic acid	<500
Sodium dehydroacetate	<500

The using of Piuseria AMC **in body soaps** and other products can be expected to **prevent *C.albicance*** and its associated **irritation**.

◆Formulas(for face)

Formulation for Face Wash ～Foaming Pump type～

It's an amino acid-based pump foam cleansing formula that is gentle on the skin, with a fine, perfect lather. The combination of PIUSERIA AMC is also expected to have bacteriostatic properties against *C.acnes* and *C.albicance*.

	INCI Name	wt%
A	Water	12.95
	Disodium EDTA	0.05
	Glycerin	10.00
	Sorbitol, Water	8.00
B	Sodium Cocoyl Glutamate, Water	30.00
	Sodium Lauraminopropionate, Water	10.00
	Lauryl Hydroxysultaine, Water	10.00
	Sodium Lauryl Glycol Carboxylate, Water	10.00
C	Polyquaternium-7, Water, Sodium Benzoate, Citric Acid	0.40
	Polyquaternium-39, Water, Sodium Benzoate	0.40
	Citric Acid, Water	7.50
	Phenoxyethanol	0.50
	Iodopropynyl Butylcarbamate, Hydroxypropyl Cyclodextrin, Water	0.20
	Total	100.00

<Process>
①Heat and mix A at 60°C.
② Add B to A and mix and stir.
③ Cool A+B to 40°C.
④ Add C to the A+B mixture and mix uniformly.

Formulation for Face Wash ～Cream type～

It's an amino acid-based facial cleansing cream that is gentle on the skin with a thorough wash. The combination of PIUSERIA AMC is also expected to have bacteriostatic properties against *C.acnes* and *C.albicance*.

	INCI Name	wt%
1	Acrylates Copolymer（31%aq）	6.00
2	Water	16.40
3	Potassium Cocoyl Glycinate, Water	50.00
4	Glycerin	5.00
5	Sodium Lauraminopropionate, Water	6.90
6	Petrolatum	10.00
7	Hydroxypropyl Starch Phosphate	4.00
8	Polyquaternium-7, Water, Sodium Benzoate	1.00
9	Phenoxyethanol	0.50
10	Iodopropynyl Butylcarbamate, Hydroxypropyl Cyclodextrin, Water	0.20
	Total	100.00

＜Process＞
1) Mix 1 and 2 (Propeller mixer=about 150).
2) Add 3 to 1) and mix (Propeller mixer=about 150).
3) Add 4 and 5 to 2), mix and stir, and heat to 70° C.
4) Add 7 to 6, and heat to 70° C and mix.
5) Add 4) to 3) and mix (Propeller mixer=about 150).
6) Cool 5) to 40° C.
7) Add 8, 9, and 10 to 6) and mix uniformly.

For detailed information, please contact below.
Sanyo Chemical
https://www.sanyo-chemical.co.jp/eng/

◆Activity Report

33rd Congress ifscc
4-7 September 2023 BARCELONA | Rethinking Beauty Science

Sanyo Chemical

World's first approach for preventing itching and dandruff by reducing the amount of surfactant residue on the skin

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[1]Beauty & Personal Care Dept., Sanyo Chemical Industries,Ltd., Kyoto, Japan

Introduction

Background

Cosmetics are composed of water, oil, and surfactants. However, because of surfactants frequent physical contact with skin, it is necessary to pay sufficient attention to their effects on skin, such as irritation and itchiness.

Okasaka et al. [1] have been reported that anionic surfactants reduce the skin barrier function, not only sulfate-based and soap-based, but also glutamic acid-based. However, only few studies have examined the adsorption of surfactants to the stratum corneum in terms of physical properties such as ionic properties and critical micelle concentration (CMC) has not yet been comprehensively investigated.

Objective & hypothesis

In this study, we investigated a completely new materials and methods.

We hypothesized that the adsorption of anionic surfactants on the stratum corneum should not only depend on the ionic properties of the anionic surfactant, but also on the CMC of the entire detergent. In addition, since itching of the scalp requires consideration of the effect on bacterial (*Malassezia restricta*) activity, these factors were also examined.

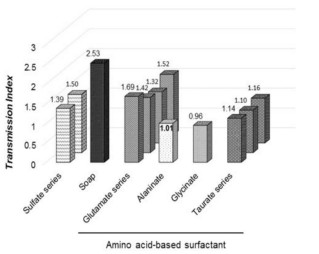


Figure 4. The Transmission Index values of the surfactants classified by series.

High adsorption of anionic surfactants to the stratum corneum of the skin
↓
Lowering the skin barrier function
↓
Increasing transmission of surfactants and other materials into skin
↓
irritation, itchiness

Materials & Methods

Samples

Surfactant	abbr.	Structure
Sodium polyoxyetylene lauryl ether sulfate (Sodium laureth sulfate)	AES	$C_{12}H_{25}O(CH_2CH_2O)_nSO_3Na$
Sodium lauroyl glutamate	AG	$C_{12}H_{25}CONHCHCH_2CH_2COONa$ (COOH)
Sodium Lauroyl Methylaminopropionate	AMA	$C_{12}H_{25}CONHCH(CH_3)COONa$
Sodium cocoyl methyltaurate	AMT	$RCON(CH_3)CH_2CH_2SO_3Na$ R:Coconut oil fatty acid residue
Cocamidopropyl Betaine	CAPB	$RCONHCH_2CH_2CH_2N(CH_3)_2CH_2COO$ R:Coconut oil fatty acid residue
Sodium Lauraminopropionate	LAP	$C_{12}H_{25}NHCH_2CH_2COONa$

Measurement of CMC (critical micelle concentration)

The surface tension of the aqueous solution containing anionic and amphoteric surfactants was measured. Using a pendant drop type surface tension measuring device (manufactured by Kyowa Surfaces Science Co., Ltd.).

Calculation of Molecular Occupied Area

Experiments were conducted with reference to the literature by Endo et al. [6] Using the plot of surface tension versus concentration during CMC measurement, the maximum surface excess concentration (Γmax) was calculated by Gibbs' adsorption isotherm expressed in the following equation (1). Further, the molecular occupied area A (Å^2) was further calculated by the following equation (2).

$$\Gamma max = (-d\gamma/dlnC)max / RT \quad (1)$$

$$A = 1 / N\Gamma max \quad (2)$$

In the formula, γ is the surface tension, R is the gas constant, T is the absolute temperature, C is the surfactant concentration, and N is the Avogadro number.

Keratin powder adsorption amount

Keratin powder adsorption amount was measured based on Nakama et al. [2].

Skin irritation

Skin irritation was measured based on OECD TG439 [3] and cell viability was analyzed *in vitro*.

MIC (minimum inhibitory concentration)

Colonies of each bacterium cultivated on agar medium were inoculated onto liquid medium, and then incubated in a stepwise diluted surfactant solution. The presence or absence of bacterial growth was determined by the turbidity after incubation.

Results & Discussion

1. Adsorption index

Keratin powder adsorption amount ∝ A completely new method **Adsorption index**

CMC of the entire detergent × **(skin pH – pKa of surfactant)**

CMC of the entire detergent: Changeable depending on the combination of surfactant

(skin pH – pKa of surfactant): 5.5, Unchangeable

Unchangeable

Apparent molecular weight of surfactant

✔500 Dalton rule is considered important for percutaneous penetration into the stratum corneum [4].

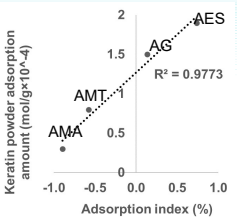
The percutaneous permeability
<500 : Improved
(common surfactant monomer)
>500 : Suppressed
(forming micelles)

✔ CMC : The concentration that surfactants forms micelles.

Anionicity of anionic surfactant at skin pH

✔Surfactants with strong anionic properties, such as AES, are known to be highly irritating and to be adsorbed to the stratum corneum in large amounts [5].

✔The Henderson-Hasselbarch equation(*) was transformed to define the strength of anionicity of anionic surfactant at skin pH (5.5).



(*) pH = pKa + Log([A-]/[HA])

R-COOH → RCOO⁻ + H⁺

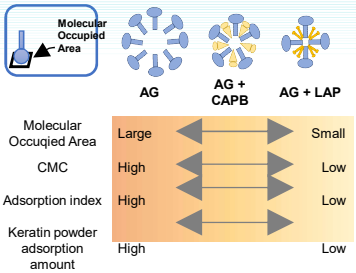
[HA] [A-] [H+]

Log([A-]/[HA]) = pH - pKa

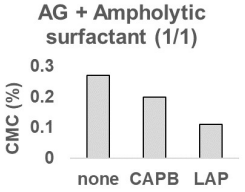
✔In detergents, Anionic and amphoteric surfactants are generally used in combination.

✔By changing the combination of surfactants, the CMC of the entire detergent can lower.

2. Lower CMC by reducing steric hindrance -Molecular Occupied Area



Ampholytic surfactant	CMC (%)	Molecular Occupied Area (Å^2)
CAPB	0.93	377
LAP	0.05	40.4



3. Decreasing irritation

Skin irritation test
Tested with a human 3D cultured epidermis model

Anionic/Ampholytic surfactant = 0.5%/0.5%	Irritation
AG/CAPB	Positive
AG/LAP	Negative

4. MIC

	MIC(ppm)	*Malassezia restricta*
Ampholytic surfactant	CAPB	1500
	LAP	200
antifungal agent	Fluconazole	4
	Ketoconazole	0.06

✔ LAP has a propionic acid structure (CH_2CH_2COOH) that is not found in other surfactants. Propionic acid is known to have antibacterial properties.

Conclusions

- We investigated a completely **new method, the adsorption index** defined as **"anionicity of anionic surfactant at skin pH x CMC of detergent"**.
- Focusing on steric hindrance, reducing the molecular occupied area as a method to lower the adsorption index, we examined the use of **sodium lauraminopropionate (LAP)**, a type of amphoteric surfactant. LAP effectively lowered CMC and also reduced skin irritation compared to Cocamidepropyl Betaine (CAPB).
- LAP also has antimicrobial properties, which may inhibit dandruff-derived scalp itchiness.
- **Reducing the amount of adsorbed surfactants in the stratum corneum can suppress barrier disruption and consequently alleviate skin irritation. This study should contribute to the development of safe and secure cosmetics.**

1. Okasaka M, et al (2018) Evaluation of anionic surfactants effects on the skin barrier function based on skin permeability. PHARMACEUTICAL DEVELOPMENT AND TECHNOLOGY. 24:99-104.
2. Nakama Y, Yamaguchi M, et al (1992) Adsorption of Cationic Surfactants to Keratin Powder. Japan Oil Chemists' Society. 41:336-340.
3. OECD.(2015) OECD GUIDELINES FOR THE TESTING OF CHEMICALS. Test No. 439: In Vitro Skin Irritation: Reconstructed Human Epidermis Test Method. OECD Publishing; p. 1–26.
4. Bos JD, Meinardi MM (2000) The 500 Dalton rule for the skin penetration of chemical compounds and drugs. Experimental Dermatology. 9:165-169.

For detailed information, please contact below.
Sanyo Chemical
https://www.sanyo-chemical.co.jp/eng/