

## Abstracts

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Skin Surface Friction and Sensory Evaluation  
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Sensory properties are very important in efficacy tests of cosmetic products. Several devices for the measurement of tactile sensory properties have been developed in recent years, and we have studied skin surface friction and examined the correlation with skin physiological parameters. The purpose of this study was to determine the relationship between skin frictional parameters and sensory evaluation after application of cosmetics. A KES-SE Frictional Analyzer (Kato Tech Co. Ltd., Japan), a commercial device for the measurement of surface frictional characteristics, was used in this study. An arm holder was added to this device for measurement on the human forearm. Frictional coefficient (MIU) and its mean deviation (MMD) were used as parameters of surface friction. The moisture content in the stratum corneum was measured with a Corneometer CM825. MIU and MMD were measured immediately, and at 1.5, 4, 5.5 and 7 h after application of 9 kinds of moisturizing emulsion with different textures, and the sensory evaluation was made by 6 experts and 149 consumers at almost the same time as the frictional measurement. In the comparison of sensory score with frictional properties, MIU showed a high positive correlation coefficient with hydrate, oily and sticky, while inversely with slippery and dry. It was also shown that oily (aburapposa in Japanese) and hydrate (shittori in Japanese) properties of cosmetics could be examined separately using MIU and MMD. In addition, the changing pattern of MIU with time after application of cosmetics to skin was correlated with fit (najimi in Japanese) assessment. This

instrumental analysis may be useful to predict the tactile impression of cosmetics on human skin.

Efficiency Characterization Index for Constituents in External Preparations on Wound Healing  
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The healing effect of local preparations containing bovine blood or hydrocortisone was examined on open wound of rat skin. The wounds were produced by application of 10mm-diameter-punch. The wound areas were copied to transparent film and were measured with an image analyzer every day. From the results of our experiment, it was demonstrated that the rate of wound healing became smaller with decreasing wound area. And in this study, the cell division rate  $h$  was found to be an indicative parameter of wound healing rate.

Usefulness and Technology of Foundation  
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The advance of foundation makeup technology has made remarkable progress these ten years. The study of formulation, utility or makeup effect have been reported not

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only in Japan but also in IFSCC and many studies have received prizes. I would like to describe the advance of foundation makeup technology by explaining some research which has been reported.

**Mechanism and Regulation of Body Malodor Generation  
— Development of a Novel Deodorant Powder and Application to Antiperspirants—**

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It is well known that short-chain fatty acids, amines and steroids generated by microbial metabolism are the principal compounds responsible for body malodor. We newly identified vinyl ketones (1-octen-3-one, cis-1,5-octadien-3-one) in body odor and found those ketones are also key compounds in axillary malodor. The purpose of this study was to develop a high performance powder, which has quenching efficacy not only for the short-chain fatty acids and amines, but also vinyl ketones. By investigating various powders known to have quenching efficacy, we finally developed a highly porous silica bead containing magnesium oxide. We found that the superior deodorant effect performed by this powder was the result of the multiple effects of both an excellent physical adsorption capability due to its high porosity and a specific adsorption of vinyl ketones to the magnesium in the powder. An antiperspirant formulation containing both the powder and *Morus alba* extract showed good efficacy as a deodorant.

**Development of New Acid Dye Remover Based on Solvent Characteristics**

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As evidenced by the current prevalence of brown hair among Japanese, the number of people using hair coloring is increasing. The reason for this is that it is becoming more socially acceptable to color one's hair to match mood or clothing or to hide gray hair. The number of people using acid dyes is on the rise, due to their convenience of use. However, the number of complaints of skin staining caused by acid dyes is also increasing. Stains on skin caused by

acid dyes generally can not be removed easily. There is no established method for removing stains caused by acid dyes completely and easily. Nishizawa and his colleagues reported the development of acid dyes that do not easily adhere to the skin. However, there is still a great need for new dye removal methods. Therefore, we evaluated solvents and activators of removers by assessing skin permeability and elution from the skin, in order to develop a remover that can easily and safely remove acidic stains from skin.

**Mechanism and Regulation of Body Malodor Generation  
—Effect of Iron on Axillary Malodor and of Anti - Oxidant on Deodorant—**

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We evaluated axillary malodor extracted from 66 adult men to identify their key compounds so that deodorants can be formulated to be more effective against them. Using sensory evaluation, we classified the malodors into five groups. Using GC/MS and GC/Olfactory analysis, we identified two key compounds: the vinyl ketones 1-octen-3-one (OEO) and cis-1,5-octadien-3-one (ODO). Both have a very strong metallic odor and a very low odor threshold. Examination of their generation mechanism revealed that the iron and the unsaturated fatty acids in the living body were related. *Morus alba* was found to repress the generation of these vinyl ketones due to its remarkable anti-oxidation effect.

**A New Dermatological Availability of the Flavonoid Fraction from Licorice Roots**

—Effect on Acne—  
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In the course of our studies on the further application of licorice as a cosmetic ingredient, we studied a new

dermatological availability in the licorice extract containing licochalcone-A as a main principle, Polyol Soluble Licorice Extract P-U, prepared from the roots of *Glycyrrhiza inflata* Batalin. As a result, this extract showed several activities such as inhibitory actions of testosterone 5 $\alpha$ -reductase, lipase and phospholipase A2, as well as androgen receptor

antagonist, antimicrobial and SOD-like actions, which relate to skin care, especially the suppression of acne formation and development. On basis of this evidence, a trial of Polyol Soluble Licorice Extract P-U with acne patients was carried out and the efficacy was demonstrated clinically.

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Mechanisms of the Immune System We Want to Understand

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How was the immune system generated in living beings? What pathways were present to reach the developed immune system seen in mammals in phylogeny? If we could answer the above-mentioned questions appropriately, we would easily understand the complex immune system in our body.

A Natural Moisturizing Factor, L-2-Pyrrolidone-5-Carboxylic Acid (L-PCA) Enhances Blood Circulation by Modulating Constitutive NO Generation

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This study revealed a new physiological function of 2-pyrrolidone-5-carboxylic acid (L-PCA), which enhanced blood circulation by modulating constitutive nitric oxide (NO) generation. It is well known that NO, generated from L-arginine (L-Arg) by catalysis of NO synthase (NOS), plays a key role in the control of vascular tone and peripheral blood flow. We found a dose-dependent enhancement of constitutive NO generation by L-PCA in the human aortic endothelial cells (HAECs). In contrast, D-PCA had no influence on NO generation. Furthermore, L-PCA stimulated L-Arg uptake into HAECs dose-dependently, while D-PCA had no effect as same as NO generation. The L-Arg uptake and its stimulation by L-PCA to HAECs were suppressed with additional of L-NMMA, an inhibitor for the cationic amino acid transporter (CAT). These results indicated that enhancement of NO generation by L-PCA is due to the increase of L-Arg uptake via the CAT pathway. In conclusion, L-PCA was found to enhance blood circulation by modulating constitutive NO generation. Then we confirmed that

the occlusive patch test of L-PCA to the volar forearm skin led the redness of skin, and which in turn enhanced the blood flow temporarily. This new function of L-PCA suggests development of innovative cosmetic products to care for such problematic skin as dark circles under the eyes.

Age and Menopause-Related Changes in the Fluorescence of Human Skin

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The ratio of 390 nm/430 nm fluorescence in the skin induced by 325 nm-excitation light has been used as a marker of photoaging, because that fluorescence ratio in sun-exposed skin decreases with aging. Here, we investigated age and menopause-related changes in the fluorescence of human skin. Test subjects in this study included a juvenile group (age 20-39 yr; median 30.1 yr, n=10), a pre-menopausal group (age 40-59 yr; median 50.1 yr, n=19), and a post-menopausal group (age 40-59 yr; median 54.3 yr, n=23). The ratio of 390 nm/430 nm fluorescence intensity was determined from the emission spectra obtained from skin (cheek and upper inner arm) exposed to 325 nm excitation light. In the cheek skin, the ratio of fluorescence intensity decreased with age, while no significant change was observed in upper inner arm skin, which is considered a non-solar area. The ratio of fluorescence intensity of the cheek skin in the post-menopausal group was significantly lower than that of the juvenile group, while no significant difference was observed between the juvenile group and the pre-menopausal group. No significant difference was observed in upper inner arm skin. The difference of average age between the pre-menopausal group and the post-menopausal group was only 4.2 yr. These results suggest that the decrease in female hormones followed by menopause accelerate photoaging of the skin.

### Investigation on Effective Measures to Alleviate Leg Swelling

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Massage is known to be useful for reducing leg swelling. In the present study, measures to improve the effectiveness of self-massage for the treatment of leg swelling were investigated in an attempt to develop a useful cosmetic product. In ten healthy women with subjective symptoms associated with leg swelling, the degree of swelling was assessed using the water displacement method, and the results showed a 2.5A% increase in leg volume toward the evening. In these women, after five minutes of self-massage and six minutes of hot-cold therapy, the results revealed a 2.5% decrease in leg volume, thus clarifying that this type of therapy does effectively reduce swelling. Consequently, we attempted to develop a cosmetic product based on hot-cold therapy, and it was found that a "cracking foam" product made by mixing a conventional gel agent and a high concentration of liquefied petroleum gas (LPG) was more effective in alleviating swelling in comparison with the other existing products.

A high Performance Hair Treatment to Enhance Hair Strength Based on a Novel Self Cross-Linking Polymer  
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The objective of the work was to develop a novel self cross-linking polymer capable of enhancing hair strength with fast and long-lasting effects. Our initial approach was to synthesize a homopolymer possessing reactive alkoxy silyl groups in order to effect chemical cross-linking of the polymer chains on individual hair fiber after application. Such a cross-linking reaction is accelerated by moisture and heat. This methodology proved to be successful to result in the formation of a film with high durability against repeated shampoos. Furthermore, we improved this initial polymer by incorporating other functional groups. In particular, we prepared copolymers of alkoxy silane and (1) methylmethacrylate, to increase the T<sub>g</sub> of the polymer, (2) methyl siloxane units, to increase the flexibility, and (3) trimethylammonium units, to enhance the affinity of the polymer to hair. The quaterpolymer containing these four functional groups in suitable ratios was shown to form rapidly a film coated individual hair fiber as an "artificial cuticle," improved hair strength without film cracking and smoothed the texture of the hair. The performance of the polymer was evaluated by a bending test to estimate its resilience and the durability against repeated shampoos. Subsequent field tests on human hair confirmed that the formulations containing this polymer succeeded in improving hair

manageability and healthy appearance, creating volume, and keeping the hairstyles ideally for an extended time period.

### Application of Urethane Polymer as a Hair Styling Agent -The Developments and the Properties of Elastic Setting Agents "Polyurethane Dispersion"

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There are a wide variety of hair styling products with various setting effects. Methyl carboxy betaine/alkyl methacrylate copolymer, vinylpyrrolidone/vinylacetate copolymer, acrylates/diacetoneacrylamide copolymer, etc., are used as hair setting polymers. These synthetic polymers can form films with the volatilization of water or ethanol on the hair surface. Consumers are divided into two groups in terms of their preference. One group, those who are concerned with a good setting effect, want to use a strong hold type hair styling product which contains a polymer that forms a very hard film. The other group, who also prefer a good setting effect, use a soft hold type to avoid an undesirable hair feeling. A noble polymer named "Polyurethane Dispersion" has been developed for the latter. Polyurethane Dispersion is a self-emulsifying polymer containing a urethane bond in its main chain. Film properties of Polyurethane Dispersion are soft and elastic. Therefore, the polymer can give a high setting effect with a good hair feeling. Furthermore, the polymer also shows a good thickening property and a high humidity tolerance. Polyurethane Dispersion is recognized not only as a good thickener but also as an agent that can yield excellent adhesive and setting properties of hair. A styling mousse and a styling gel with this new Polyurethane Dispersion can result in a long-shelf-life product without stickiness or flaking. Polyurethane Dispersion is a new hair setting polymer that can give "natural style"

### Application of Carboxyl Modified Silicones to Cosmetic Surfactants

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The application of carboxyl modified silicones as a surfactant was studied. Carboxyl modified silicones, which were neutralized with triethanolamine, were used in this study. The results of a emulsification test of dimethylpolysiloxane indicated that both water-in-oil and oil-in-water emulsions could be prepared by changing carboxyl equivalents. In particular, a high

internal phase water-in-oil emulsion was formed by using a high-equivalent carboxyl modified silicone. On the other hand, an aqueous solution of neutralized low-equivalent carboxyl modified silicone showed good detergency for a spot of decamethylcyclopentasiloxane. These results suggest that carboxyl modified silicones are valuable for cosmetics.

Prevention of Color Transfer through Interaction of Over-Coating Film and Pigment Layer  
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The prevention of color transfer to cups and clothing is very important in lip color products. A common method of minimizing color transfer is to use a film-forming polymer dissolved in a volatile oil in a lip color formula. However, this approach requires the user to wait several minutes to allow solvent evaporation. The result is often unsatisfactory as color transfer can still take place even after drying. To prevent color transfer effectively without any waiting period, we devised a novel dual approach utilizing over-coating. The first is to reduce the mobility of the lipstick film by a dynamic diffusion of the gelling agent from the over-coating to significantly increase the lipstick film viscosity. This is accomplished by carefully controlling the heat of immersion of the solvent in the over-coating such that

its value is lower than that of the lipstick. Secondly, a continuous lipophobic film is formed over the applied lipstick film by allowing a lipophobic materials in the over-coating to penetrate into the lipstick film through dynamic migration. Extensive investigations on solubility and heat of immersion of many lipophobic materials revealed polyperfluoromethylisopropylether (PF) to be the most suitable for this purpose. From our infrared spectroscopy studies, we were able to confirm the dynamic migration of both silica and PF into the underlying applied lipstick film, when incorporated into a protective over-coating. We tested our new approach in practical applications by formulating a novel film-former designed to be worn over applied lipstick and found that the film provides perfect and immediate long-lasting color protection without a long waiting period after application.

The Relationship between Moisture Content and Mechanical Properties of Fingernail (Part 4)  
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It is well known that nail damage such as yellowing, split nails and peeled nails (onychoschisis) are caused by continuous use of nail enamel for a long period. Within serious nail damage, we investigated how to prevent the appearance of split nails and peeled nails. The results showed glycolic acid was effective for those kinds of nail damage.