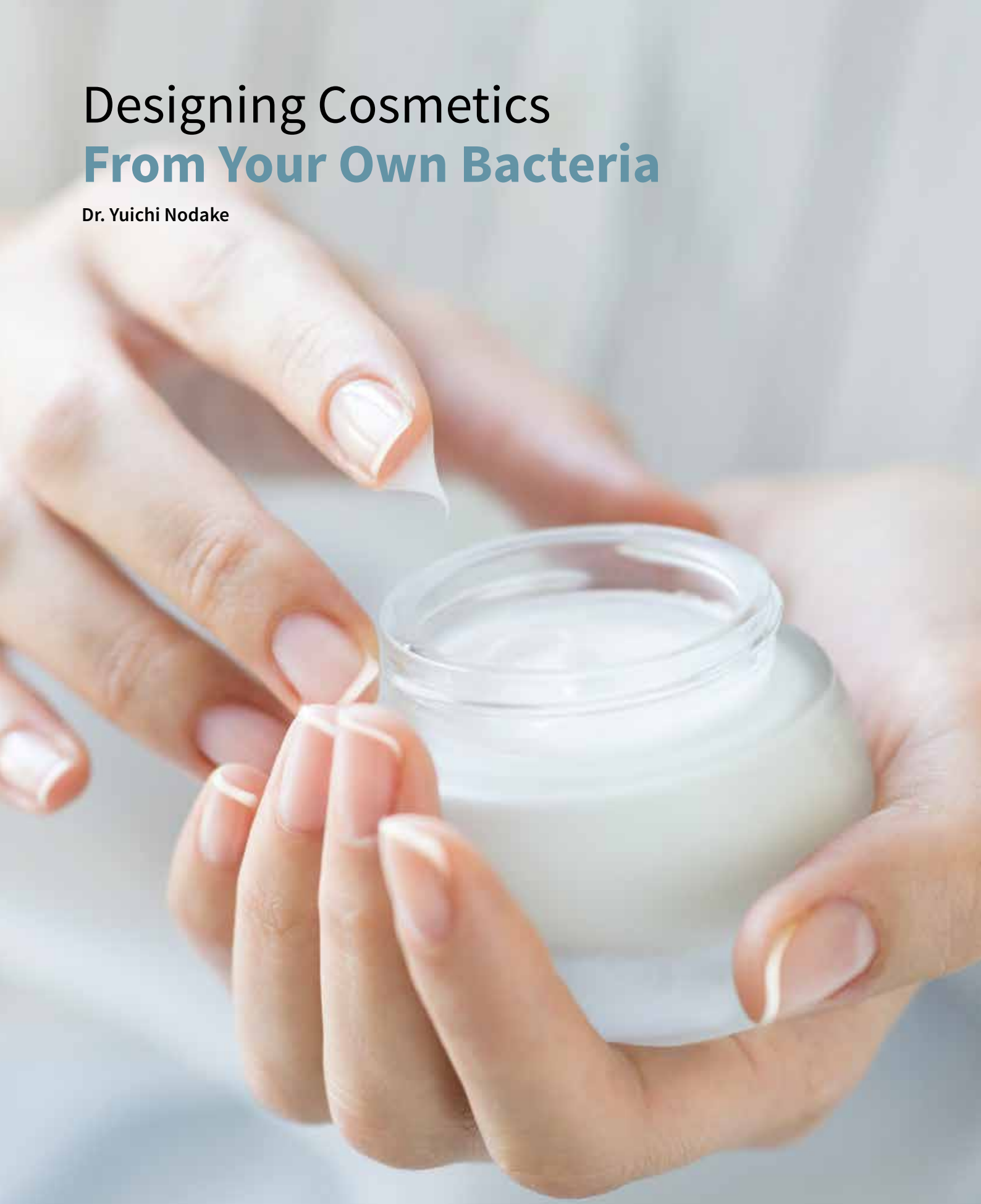
Designing Cosmetics
From Your Own Bacteria

Dr. Yuichi Nodake



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Designing Cosmetics From Your Own Bacteria

Dr. Yuichi Nodake studied a way to take Staph epi—a normal skin bacterium—and literally turn it into a probiotic cosmetic to aid in skin moisturizing and even repelling harmful bacteria like Staph aureus.

What attracted you to studying normal skin bacteria and making cosmetic products from them?

It is very difficult to find basic cosmetics that optimally suit each person's needs. Therefore, we wanted to produce more natural cosmetics for women.

The skin care effects induced by the normal skin bacterium *Staphylococcus epidermidis*—or Staph epi—have recently attracted attention in the world of cosmetics. Numerous preparations that facilitate the growth of Staph epi on the skin surface have been developed to exploit the natural benefits induced of Staph epi. We thought that an intentional and substantial increase in Staph epi on the skin would boost the levels of natural substances and improve skin health.

Most people know that yogurt is useful to improve the intestinal bacterial population and prevent various gastrointestinal problems. This is referred to as probiotics. In the same way, it might be possible to improve skin health by controlling skin bacteria with "probiotic cosmetics". There have been no previous attempts to develop skin probiotics like this. We sought to create such a product and focused on Staph epi as the candidate microorganism.

Your study dealt with *Staphylococcus epidermidis* taken from healthy subjects' skin. How is that bacterium different from the staph organisms we always hear about that cause serious infections, like *Staphylococcus aureus?*

Staph epi is a normal bacterial inhabitant of the human skin surface, with a density of up to 100,000 organisms per square centimetre on the face. Staph epi infections are restricted to people with compromised immune function or patients with indwelling catheters who receive various medical treatments. Normally people have Staph epi on their skin and it causes no problems. We figured that Staph epi could be suitable for use in a probiotic cosmetic.

Your study took bacteria from the patient's skin, multiplied it, and then mixed lyophilised (freeze-dried) bacteria with gel to apply to the skin to increase skin lipids and improve skin hydration. How would this be an improvement over simply mixing some type of oil and hydrating agent to the gel? Why are the bacteria better?

In this study, individual Staph epi samples from each subject were mixed for 30 seconds in a facial gel containing primarily water and minimal minerals. The subject applied the resulting mixture of the individual Staph epi sample on her face for 30 seconds. We don't know whether this specific strategy will ultimately be the most suitable way to achieve the desired results, but it's a start.

But the real point is, Staph epi has a unique symbiosis with humans—Staph epi provides not only a moisturizing effect by producing glycerine and related substances, but it also produces an active antimicrobial peptide that combats harmful bacteria like *Staphylococcus aureus* from attaching to the skin.

You applied for a patent based on the results of this study. What is the patent for and what will you do with it if it is granted?

Our skin care method using cultured Staph epi—augmentation with Staph epi—clearly differs from other basic cosmetics containing compounds that replenish moisturizing factors in the skin or increase the amount of Staph epi. Because we think our skin care method has unique novelties, we have applied for a patent. Our findings regarding augmentation with Staph epi may serve as a driving force to accelerate the development of a novel, personalized basic cosmetic that can provide long-lasting beneficial skin care effects.

Who were your collaborators in this research?

I had three collaborators in this research. Dr. Ryuzo Sakakibara, from Nagasaki International University, has a multidisciplinary research background. His current research is focused on understanding the bioactivities of fermented products by lactic acid bacteria. One of his current research interests is preventive medicine.

Dr. Itaru Dekio, of Tokyo Women's Medical University, is a foremost researcher in dermatological sciences. He analyses the relationship between skin bacteria and skin health and is interested in development of novel therapeutics for atopic dermatitis.

Mr. Hidetoshi Honda is a president of BIOGENOMICS Co. Ltd (Omura, Nagasaki, Japan). He has been interested in the importance of intestinal and skin microbiota. He has visions and methods to apply useful functions of bacteria to our health.

Do you have plans to extend this study in the future or focus elsewhere?

Because the growth of Staph aureus and pathogenic fungi is suppressed under low acidic conditions, because Staph epi produces antimicrobial substances to inhibit the colonization of Staph aureus, and because Staph epi contributes to skin defences by enhancing the activation of defensive chemicals in skin cells, the augmentation with Staph epi may be useful to prevent skin diseases probiotically. Staph aureus frequently colonizes the eczematous skin of patients with atopic dermatitis and is believed to be an important precipitating factor of atopic dermatitis. This means the elimination of Staph aureus is important for the treatment of atopic dermatitis. We hope that our augmentation with Staph epi can improve moisture retention, rough texture, and skin pH, which could be applied as an effective therapeutic method for atopic dermatitis.

Helping Mother Nature Do Her Job With Germs

The drive to find a better skin lotion leads researchers in many directions. Dr. Yuichi Nodake of the Department of Biochemistry at Nagasaki International University has taken a common skin bacterium and used it to produce a novel skin treatment that lubricates and hydrates the skin "naturally".

VANITY, VANITY, ALL IS (NOT?) VANITY!

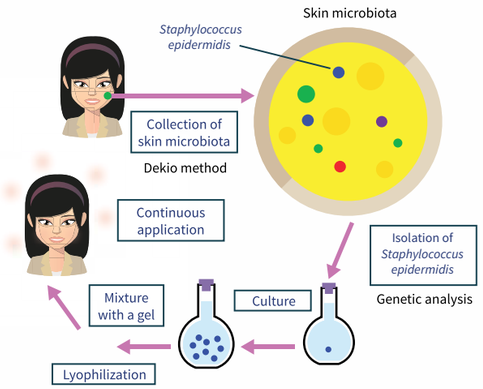
Women and now men, are constantly seeking better cosmetics to take care of their skin. Maybe this is vanity, maybe it's fear of aging, but it's certainly a fact. However, it is difficult to find good skin products that optimally suit one's personal needs. Is this product for oily skin or dry skin? Am I allergic to the components? Does it even work? And these days, there is always the push for "natural" products—the bias against "artificial" ingredients.

Dr. Yuichi Nodake has recently turned his attention to the science of cosmetics. His expertise in agricultural science—including the biochemistry and immunology of various food components and related bacteria—has led him to theorize that a common skin bacterium, *Staphylococcus epidermidis,* might be useful as the foundation for a novel type of cosmetic, a probiotic cosmetic, that is both natural and designed for the specific individual. And far from serving just vanity, Nodake thinks Staph epi can be used to better protect the skin against infection by dangerous pathogenic bacteria like *Staphylococcus aureus.* Taking a cue from the so-called probiotic treatments for stomach ailments that reinforce the "normal" microbiologic flora of the intestines, Nodake and his colleagues published a pilot study in 2015 in the Journal of Dermatological Science looking at the augmentation of normal skin bacteria to help moisturize the skin and perhaps inhibit Staph aureus.

THE GOOD, THE BAD . . . AND THE THEORY

Staph epi is a common and normal inhabitant of human skin. Recent research has shown that Staph epi is quite the beneficial bacterium, actually participating in the maintenance of skin health. Metabolic products produced by Staph epi, including glycerine and other organic acids, tend to improve skin moisture retention, help maintain a low pH on the skin surface, and also improve rough skin texture. In addition, Staph epi produces the enzyme superoxide dismutase, a known destroyer of reactive oxygen species. Since reactive oxygen species—free radicals—are associated with cell aging, Staph epi may actually help prevent wrinkles and other effects of skin aging.

Augmentation with Staphylococcus epidermidis



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All these effects are good from the point of view of cosmesis. But more than that, certain antimicrobial substances produced by Staph epi actually help suppress the colonization of the skin by the pathogenic bacterium Staph aureus. Staph aureus is associated with a wide variety of conditions ranging from subclinical inflammation to severe infections like pneumonia, endocarditis and septicaemia. So the effects of Staph epi on the skin are beneficial both for cosmetic purposes as well as disease prevention.

There have already been some attempts to develop products to increase the growth of Staph epi on the skin to exploit the bacterium's potential benefits. However, the stimulating effects of these preparations on the colonization of Steph epi and other skin bacteria are often insufficient because of the differences in the skin characteristics of individuals and the gradual depletion of active substances in these products induced by the metabolism of the skin bacteria as they grow. Further, a number of basic cosmetics contain oligosaccharides—short chain sugars—to facilitate the colonization of Staph epi. Unfortunately, they also have the undesirable property of promoting the growth of Staph aureus. In other words, if you feed skin bacteria, they all increase in numbers, both Staph epi as well as other, less desirable bacteria. What Nodake aimed to do is design a cosmetic to increase the numbers of Staph epi—and only Staph epi—on the skin surface. That way you get a pure increase in the good bacterium and no parallel growth in any bad bacteria. Of course, using "good" bacteria to promote health like this is the aim of probiotics.

BYOB: BRING YOUR OWN BACTERIA

Nodake's pilot study consisted of 21 subjects—all adult women with normal skin—who were

recruited in 2012 and studied for approximately three months. Swabs were taken of the subjects' forehead skin and tested for various organic acids, pH and moisture, as well as used to isolate colonies of Staph epi from each individual subject. Those isolates of Staph epi from each patient were cultured in the laboratory to get large numbers of bacteria—ultimately concentrations of 1,000,000,000 cells per millilitre. Those individual lots of bacteria were then lyophilised—freeze dried—and preserved for later use in the study.

The 21 subjects were randomized in a blinded fashion into a group of 13 who were inoculated with their own bacteria and a group of 8 who constituted the control group. The freeze-dried bacteria were mixed with a facial gel that was made primarily of water with minimal minerals. Gel with bacteria was used on the 13 subjects in the active group and gel with powdered milk instead of bacteria was used in the control group. The women rubbed the gel into their foreheads twice a week at bedtime and over time swabs were taken to measure bacterial count, levels of the various organic acids, pH and moisture retention. The subjects' skin was also examined and tested for signs of irritation, such as redness. Then, after four weeks, the groups were switched and the first group got the powdered milk gel while the second group got live bacteria.

The results of the study were exactly what Nodake expected. Innoculation with the person's own concentrated Staph epi was associated with a 15-fold increase in Staph epi on the skin, first of all. But this caused increased levels of organic acids, in particular glycerine, propionic acid and lactic acid, as well as a decrease in pH from 5.5 to 5.0 and an increase in water content. There was no difference in redness or other evidence of irritation, so it was apparent that these increased numbers of Staph epi did not cause any obvious problems on the skin. In fact, Nodake had originally wondered if the subjects would complain about "stickiness" from the increases in organic acids and water content, but none of the subjects had any complaint in that regard. All in all, the results were precisely what Nodake predicted based on his knowledge of Staph epi and the underlying science. Probiotic skin treatments made with a person's own Staph epi are possible and they work.

LOOKING TOWARD THE FUTURE

Nodake and his colleagues clearly showed that a skin care method using cultured Staph epi to augment the numbers of a person's own bacteria worked as expected. This treatment clearly differs from other cosmetic strategies that used compounds that replenish moisturizing factors in the skin or increase the amount of Staph epi (and other bacteria) by using sugars or other nutrients. Their findings regarding augmentation with Staph epi from the person's own skin may serve as a driving force to accelerate the development of a new, personalized probiotic cosmetics that can provide long-lasting, beneficial, and natural skin-care effects by making the person's own bacteria do the work.

What Nodake is planning for the future is showing that augmentation of the skin flora with a person's own Staph epi is actually protective against colonization by harmful bacteria like Staph aureus. There are a number of conditions, such as eczema, where Staph aureus can cause dangerous complications. If using the person's own Staph epi can probiotically prevent such Staph aureus infections, the next step in the development of probiotic cosmetics will be achieved. It's not all just about vanity and looks, but there is health to be considered, too. And your own bacteria may be a key component in achieving both.

Researcher Profile

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Dr. Yuichi Nodake received his Ph.D. from the Division of Agriculture, Graduate School, Kyushu University. He has been interested in a variety of scientific areas, including biochemistry, agricultural chemistry, cosmetic science, and functional food science. He has published papers on the topics of "hot dog fold" proteins, the immunogenicity of cow's milk, crystallographic and biochemical analysis of a variety of important bacterial enzymes, and thermostability factors of the heat-loving bacterium Thermus thermophilus. One of his research aims is the contribution to preventive medicine. He is focused on understanding the bioactivities of probiotic cosmetics containing skin microbiome species and functional foods fermented by lactic acid bacteria.

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いつも、人から。そして、心から。
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