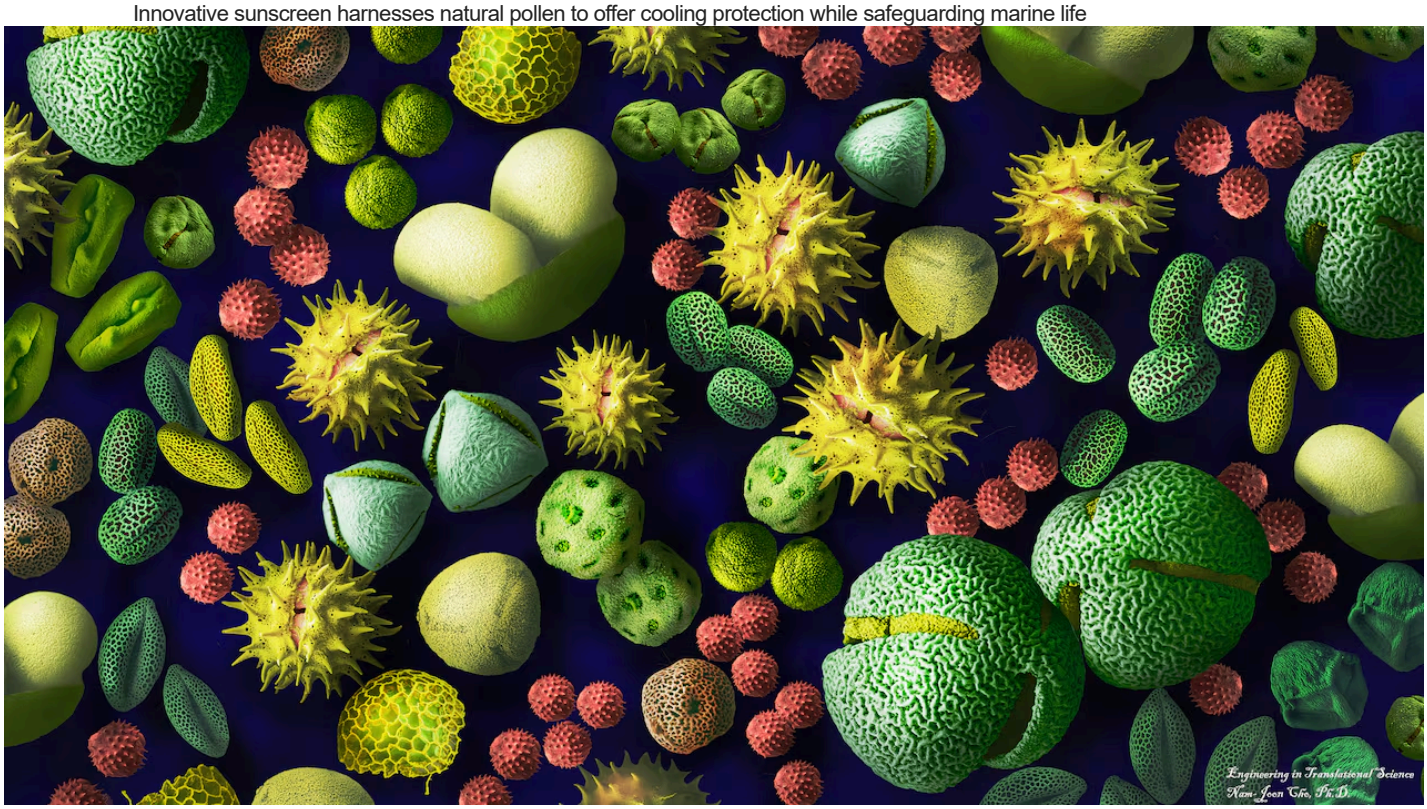
Scientists develop eco-friendly pollen sunscreen that cools and protects skin

Innovative sunscreen harnesses natural pollen to offer cooling protection while safeguarding marine life



Pollen captured by an electron microscope is transforming from an annoying presence that causes spring allergies into a protective drug capsule and sunscreen./Courtesy of Nanyang Technological University Singapore

By Yeom Hyun-a, Lee Young-wan

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Sunscreen blocks ultraviolet rays, preventing burns and skin cancer. However, it has been noted that some chemical components in certain products are harmful to marine ecosystems. A Korean scientist has developed a natural sunscreen that enhances UV-blocking effectiveness while being environmentally safe by utilizing pollen.

Researchers at Nanyang Technological University (NTU) in Singapore announced on 4th (local time) in the online edition of the international journal 'Advanced Functional Materials' that they developed the world's first 'natural cooling sunscreen' that not only blocks ultraviolet rays using pollen extracted from camellia flowers but also lowers skin temperature by 5 degrees Celsius.

Pollen, which previously caused spring allergies, is transforming into a material that protects humans. When softened, pollen can be used for drug delivery capsules or wound protectants. It has also been combined with cosmetic ingredients to create sunscreen. Since pollen is a natural material, it does not harm the human body or nature, and is abundant, thus not burdensome in price.

A research team from Nanyang Technological University (NTU) in Singapore develops a natural sunscreen that increases UV protection and is environmentally friendly using pollen. /Courtesy of Harvard T.H. Chan School of Public Health

◇Creating cosmetic gel by extracting pollen

Professor Nam-joon Cho and his research team at NTU's Department of Materials Science and Engineering removed the internal components of camellia and sunflower pollen using a water-based process without high temperatures or harmful chemicals, transforming it into a gel formulation for cosmetics. The pollen gel formed a transparent protective layer thinner than a hair strand when applied to the skin.

Animal testing conducted together with Professor Jung Ryeol Lee from Seoul National University's Medical School showed that pollen sunscreen effectively blocks ultraviolet rays and reduces skin cell damage and inflammation. Notably, camellia pollen sunscreen demonstrated superior performance compared to sunflower.

Compared to commercially available sunscreen products, pollen sunscreen displayed similar or higher levels of UV protection. Additionally, in sunlight exposure tests, a cooling effect that lowered skin temperature by up to 5 degrees was also confirmed. Researchers stated this is because pollen absorbs less visible light and near-infrared energy.

Professor Nam-joon Cho said, "Pollen can also be consumed as a dietary supplement, and the pollen shell is designed to protect the interior from environmental stress like ultraviolet rays," adding that "pollen sunscreen blocks UV rays at levels similar to titanium dioxide or zinc oxide used in regular sunscreens."

Enlarged images of sunscreen applied to the skin (left) and camellia pollen (right)./Courtesy of NTU

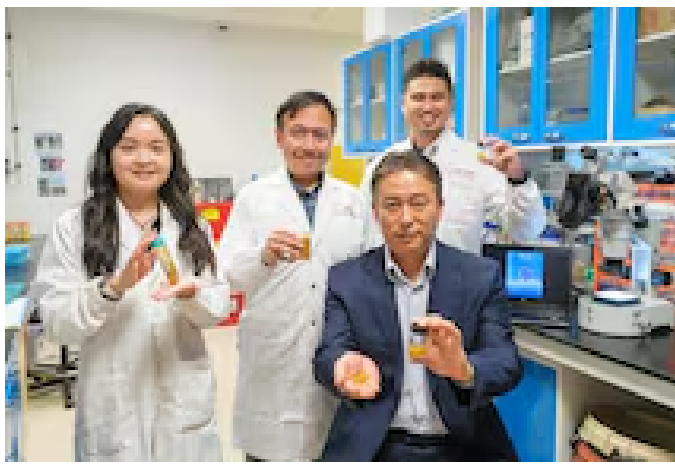
◇Sunscreens that kill corals while blocking sunlight

The researchers particularly noted that pollen sunscreen is harmless to marine ecosystems. Some existing sunscreen products contain chemical ingredients like oxybenzone and octinoxate, which are known to be lethal to the coral reefs that sustain about a third of marine life.

In fact, when the researchers applied products containing these ingredients to coral reefs, bleaching occurred within just two days as the corals turned white, and by the sixth day, the reefs died. It is estimated that about 6,000 to 14,000 tons (t) of these sunscreen ingredients enter the sea each year. In contrast, coral reefs treated with pollen sunscreen remained healthy even after 60 days.

Patrick Martin, a professor in environmental studies at NTU, commented, “This research is a meaningful attempt to protect marine ecosystems and reduce environmental pollution,” adding that “pollen sunscreen is a promising approach to safeguard both human health and marine ecosystem protection.”

Natural materials are generally more expensive than synthetic materials, but pollen is different. Plants produce pollen in large quantities to increase reproductive success. While one corn kernel contains only hundreds of grains, it releases up to 5 million pollen grains for this purpose. Pine trees can produce 2.2 kg of pollen in just a few weeks. The raw material for polylactic acid (PLA), used to make plastic, costs $3 per kg, while pollen costs just $0.01.



Professor Nam-joon Cho from Nanyang Technological University (right) and the research team hold a bottle containing pollen sunscreen./Courtesy of NTU

◇Popular for drug delivery and cell culture materials

Pollen is known as ‘the diamond of plants’ due to its strength, remaining intact for hundreds of thousands to millions of years. Thanks to this, it can be used as a medical material for cell cultivation, drug delivery, or supporting fractured areas. Professor Nam-joon Cho announced in 2020 in the international journal ‘Nature Communications’ that he developed a method to create capsules from pollen for delivering drugs within the body.

Pollen tightly encloses particles when lacking moisture, but when it meets moisture on the pistil, it opens up and releases sperm. The researchers mimicked this process by treating pollen with potassium hydroxide, increasing its volume and creating a soft gel state. Conversely, increasing the acidity caused the swollen pollen to shrink back into a firm state.

The researchers expect that when pollen becomes a soft gel state, it can be utilized as a covering material for wound protection, food packaging, or drug capsules. When pollen is in small particle form, it can trigger allergic reactions when inhaled, but as it takes on other forms, it turns into a biocompatible material that poses no harm to the human body.

Professor Jo developed a method for printing pollen materials. Together with Professors Juha Song and Taesik Jang from Chosun University, he also developed a 3D printing ink material using sunflower pollen for tissue engineering, toxicology testing, and drug delivery, which was published in ‘Advanced Functional Materials’ in 2021.

Previously, medical 3D tissues were printed using cells or biopolymers sprayed layer by layer, but maintaining the structure after printing was challenging. The firm structure of pollen resolved this issue. By treating pollen with potassium hydroxide

to increase its volume and make it a soft gel state, a mixed ink was created by combining it with hydrogel, a moisture-rich polymer material.

Professor Juha Song explained, “To reinforce strength, fibers or other particles are added, but this can cause the nozzle to clog,” adding that “pollen ink is mechanically robust and does not alter the fluidity of the ink, allowing for printing without obstructing the printer and maintaining structure after printing.”

References

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