SKIN DEEP

New Products Bring Side Effect: Nanophobia

By NATASHA SINGER

It sounds like a plot straight out of a science-fiction novel by Michael Crichton. Toiletry companies formulate new cutting-edge creams and lotions that contain tiny components designed to work more effectively. But those minuscule building blocks have an unexpected drawback: the ability to penetrate the skin, swarm through the body and overwhelm organs like the liver.

Humans have long lived in dread of such nightmare scenarios in which swarms of creatures attack. Alfred Hitchcock envisioned menacing flocks in “The Birds.” In the 1990 film “Arachnophobia” a killer spider arrives in the United States, where it attacks and multiplies.

And now comes nanophobia, the fear that tiny components engineered on the nanoscale — that is, 100 nanometers or less — could run amok inside the body. A human hair, for example, is 50,000 to 100,000 nanometers in diameter. A nanoparticle of titanium dioxide in a sunscreen could be as small as 15 nanometers. (One nanometer equals a billionth of a meter.)

“The smaller a particle, the further it can travel through tissue, along airways or in blood vessels,” said Dr. Adnan Nasir, a clinical assistant professor of dermatology at the University of North Carolina at Chapel Hill. “Especially if the nanoparticles are indestructible and accumulate and are not metabolized, if you accumulate them in the organs, the organs could fail.”

Indeed, some doctors, scientists and consumer advocates are concerned that many industries are adopting nanotechnology ahead of studies that would establish whether regular ingestion, inhalation or dermal penetration of these particles constitute a health or environmental hazard. Personal care products are simply the lowest hanging fruit.

But people are already exposed to nanoparticles. Stoves and toaster ovens emit ultrafine particles of 2 to 30 nanometers, according to the National Institute of Standards and Technology; the researchers reported last month that long-term contact with such appliances could constitute a large exposure to the smallest of nanoparticles.

Several products already use nano-engineered materials. There are “nano pants,” stain-resistant chinos and jeans whose fabric contain nano-sized whiskers that repel oil and dirt, and nanocycles made from carbon nanotubes that are stronger and lighter than standard steel bicycles. And in lotions and creams, the use of nanocomponents may create a more cosmetically elegant effect — like uniformity or spreadability.

Some ingredients may behave differently as nanoparticles than they do in larger forms. Nano-sized silver, for example, can act as an antibacterial agent on the skin. Larger particles of zinc oxide and titanium dioxide
result in white pasty sunscreens; but as nanoparticles, they appear more transparent.

When it comes to beauty products, however, some consumer advocates are concerned that dynamic nanoparticles could pose risks to the skin or, if they penetrate the skin, to other parts of the body. Mineral sunscreens have attracted the most attention.

“Substances that are perfectly benign could be toxic at the nano scale,” said Michael Hansen, a senior scientist at Consumers Union, the company behind Consumer Reports. “Because they are so small, they could go places in the body that could not be done before.”

This month, the magazine published a study it had commissioned that found mineral nanoparticles in five sunscreens, even though four of the companies had denied using them. In October, Dr. Hansen sent a letter to the Food and Drug Administration commissioner, asking the agency to require cosmetics and sunscreen manufacturers to run safety tests on nano scale ingredients. In the letter, he cited a few studies published in scientific journals that reported that exposure to nanoparticles of titanium dioxide caused damage to the organs of laboratory animals and human cell cultures.

But cosmetics industry representatives said there was no evidence that personal care products that contain nano-size components constitute a health hazard. Furthermore, no rigorous clinical trials have been published showing that cosmetics with nanocomponents caused health problems. A review of the potential risks of nanomaterials, carried out for the European Center for Toxicology in 2006, concluded that sunscreens with metal nanoparticles were unlikely to penetrate healthy skin, but it did raise the question of whether safety studies should examine if such materials may penetrate damaged skin.

“It’s very difficult to get anything through the skin,” said John Bailey, the executive vice president for science of the Personal Care Products Council, an industry trade group in Washington. “The skin is a very effective barrier.”

Indeed, some nanotechnology researchers said it was illogical to assume that a nano-size component inherently carries greater risk than a larger component. Furthermore, some say cosmetics may contain molecules like a silicone fluid called cyclopentasiloxane that are even smaller than nanomaterials.

“I think it’s a double standard because nanoparticles are less likely to go through the skin than solutions where you are using single molecules,” said Robert S. Langer, a chemical engineering professor at the Massachusetts Institute of Technology in Cambridge. He is developing nanoparticles for the targeted delivery of cancer medications, and is a founder of Living Proof, a cosmetics company that makes hair products. “The molecules in a cream are certainly going to be smaller than a nanoparticle.”

The Food and Drug Administration does not require manufacturers to list the format of ingredients on labels. The agency does require cosmetics manufacturers to ensure that their products are safe for use; in 2006, the agency created its own task force to investigate the safety of engineered nanomaterials.

Ken Marenus, the senior vice president of regulatory affairs worldwide at the Estée Lauder companies, said nanomaterials had to undergo the same kind of assessment for exposure, risk and dosage levels as any other cosmetic component. “The same toxicological standards for every chemical will apply to nano,” he said.
Dr. Bailey of the Personal Care Products Council estimated that several thousand sunscreens and cosmetics currently use some kind of nanoscale component.

Cor soap, for example, uses 50-nanometer particles of silver combined with silica that are smaller than the size of a skin pore. The material is designed to enter the pores and kill bacteria.

“The silver suffocates the bacteria and then you rinse it off with water,” said Jennifer McKinley, the chief executive of Cor. Although a study has shown that nanosilver can permeate broken skin, Ms. McKinley said the soap was safe because it contains only a limited amount of nanosilver and the particles do not remain on the skin.

Indeed, using nanoderivatives of precious metals is becoming a trend. Last year, Chantecaille introduced Nano Gold Energizing Cream, a $420 face cream that contains 5-nanometer particles of 24-carat gold encapsulated in silk fibers. Sylvie Chantecaille, the chief executive of the company, said the capsules delivered the gold particles, which work as an antioxidant, into the surface layers of the skin. “It’s a very effective way to transport beneficial ingredients,” she said.

But many beauty companies are shying away from discussing minuscule particles in their cosmetics. And that kind of avoidance may itself stoke nanophobia. For example, when La Prairie introduced its Cellular Cream Platinum Rare earlier this year, the company sent out press materials promoting “nano-sized Hesperidin Smart Crystals to protect DNA” in the formula. But, in a phone interview, Sven Gohla, the company’s vice president for research and development, distanced the brand from nanotechnology. Just because the particles of hesperidin, a flavonoid, in the formula are small does not mean they are manufactured nanotechnology, he said.

Last month, a consumer group in London called Which? published a survey it had conducted of 67 cosmetics companies on the prevalence and safety testing of nanomaterials in personal care products. Only 17 companies responded, of which eight acknowledged using nanomaterials.

“When nanotechnology was hot, everybody wanted to talk about ‘nano this, nano that.’ Look at the iPod nano,” said Dr. Hansen of Consumers Union. “But now that the concerns have come out, people are not so sure the word nano is a good thing to be touted.”