NANOPARTICLES– *sizing up skincare*

By DR. HANS LAUTENSCHLAGER

I recently read an interesting article, passed to me by my Australian colleagues. It's a long way from Germany to Australia but the issues raised in the article "I'm as Mad as Hell….." by Danne, published in the Nov/Dec 2010 issue of *Professional Beauty*, resonated with me so strongly I felt obliged to put pen to paper.

It is extremely rare for anyone involved in the skincare industry to speak up in the way Danne Montague-King has done and I applaud him for this. With decades of experience, his knowledge and passion are renowned and I agree with much of what he wrote, particularly his opening paragraph "One of the disadvantages of being 67 years of age and labelled as a 'legend' and 'pioneer' is that, in addition to making me feel ancient, it also puts me in the frustrating position of having to explain nearly everything over and over again, every ten years, to an entirely new group of beauty therapists who do not realise that everything they hear as 'popular' and 'the latest technology' is, in fact, old and sometimes bogus technology paraded all over again in new high-tech drag."

I, like Danné, have over 30 years experience in my field of expertise. After studying chemistry and physics and working in related fields I became more and more drawn to the skin care industry. I subsequently assumed a role with Nattermann & Co, Cologne, where I was in charge of the development of new pharmaceutical actives for lipid metabolism disorders, inflammation and heart, blood and circulation diseases. I later moved to research and development, in particular that of pharmaceutical and cosmetic formulations with phospholipids. For those not familiar with phospholipids they are synonymous with liposomes, nanoparticles and derma membrane structure (DMS).

Since 1998 I have owned and managed my own company, KOKO dermaviduals. working in the same field. My primary focus is now based almost entirely on phospholipids – especially on nanoparticles.

Danne touched on nanoparticles in his article, concluding with: "In this sense, nanotechnology in skin care has a future". I totally agree, but I would add one rider: "…and tomorrow is already here". It is this I wish to expand on in this article, as there is much confusion about nonoparticles in the industry and with members of the general public.

Nanoparticles have a longer history than many would suppose. Since human beings have inhabited the earth they have been exposed to small particles from a variety of sources. Aerosols (small airbound particles) have always been with us. Some examples include smoke and soot developed from fires; dust from deserts, which travel over hundreds of kilometres and microscopic seeds, grains and pollens also always in the air in some form. Soil blown by wind from fields contains mineral particles. Volcanic ash is very capable (as was evidenced by the recent eruption of the Eyjafjallajökull volcano in Iceland) of soaring and floating high into the atmosphere's upper air layers, staying there for months.

Any friction of natural or synthetic solid bodies generates tiny visible bodies but also miniature particles that cannot be detected by the human eye. Among aerosols and dusts, therefore, nanoparticles are omnipresent.

Some can have adverse effects on the human body. Examples include diesel dust (lungs), hard coal dust (lungs), asbestos particles (lungs), anti-cancer nanoparticles (injected medical iron particles; liver) and other insoluble powder-like technical nanoparticles (lungs). All the components of these nanoparticles are non-biodegradable. They behave in the body like foreign matter. Others are shown not to be harmful and I will touch on these later.

In the skin care industry two kinds of nanoparticles are used – non-biodegradable and biodegradable. Biodegradable means the components of the nanoparticles are metabolised in the same way as other compounds contained in creams, lotions etc. But how is the biodegradability of the components recognized by the consumer? In principle that's very easy to understand if you are familiar with the INCI declaration. However to the layperson, it's difficult to conceptualise so let me give some examples:

NON-BIODEGRADABLE COMPONENTS INCLUDE:

- Metal oxides like titanium dioxide (INCI) which are used for mineral sun protection. Titanium dioxide is a component of solid nanoparticles.
- Solid lipid nanoparticles (SLN) contain high-melting hydrocarbons and waxes. They combine on the skin into a surface film from which the active agents are released, similar to an occlusive mineral wax containing W/O-system. Currently there are no conclusions they are able to cause any harm.

BIODEGRADABLE COMPONENTS INCLUDE:

- Phosphatidylcholine (PC; INCI: lecithin) forms membranes around mostly vegetable oil bodies. With reference to liposomes these "fluid" or "liquid" nanoparticles are sometimes called nanosomes or nanodispersions. Other components can include physiological ceramides, phytosterols, fatty acids and vitamins.
- Liposomes differ from fluid nanoparticles by encapsulating water-soluble active agents like vitamin C; their structure is derived from natural cells.

The advantage of all these systems is the fact they don't need emulsifiers. Emulsifiers and tensides are not tolerated by many consumers, particularly those with problem skin, because of their irritation potential and their known wash-out-effect of skin components when cleansing. The average particle size of commercial cosmetic nanoparticles and liposomes is between 25 to 200 nm.

Down to the present day there are no empirical findings that cosmetic non-biodegradable nanoparticles like titanium dioxide embedded in the matrix of sun protection creams can penetrate into the skin. This also applies for diseased skin, e.g. psoriasis. Nanoparticles based on solid hydrocarbons, waxes (SLN) are also blocked off by the horny layer. They aggregate to form superficial films and then release their active agents into the skin.

Quite different are fluid nanoparticles and their hydrophilic relatives, the liposomes. They penetrate into the barrier layers of the horny layer where they dissolve immediately due to their specific composition. During this process a fluidisation of the skin barrier layers takes place and the encapsulated active agents are released and can pass through the skin barrier. A specific advantage of fluid nanoparticles is that besides lipophilic active agents, natural oils can be forced into a sensorially agreeable aqueous dispersion, without adding synthetic or barrier-disturbing emulsifiers, which easily penetrates the skin.

How can nanoparticles be misconstrued? Media tends to disingenuously or mischievously mix the facts of potentially harmful nanoparticles with the non-harmful nanoparticles that can be used in the cosmetics industry often without knowing or explaining any details. They do not look at the chemical composition and the biodegradability but instead focus only on the word "nano". I recommend looking only at the composition (INCI) of cosmetics to be sure about the tolerability. The skin (and the body) is unconcerned as to whether cosmetic formulas consist of emulsions, nanodispersions, micro emulsions or solutions. The skin (and the body) reacts only to the quality and quantity of the ingredients which are listed as components in the INCI. PB

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