

## Cosmetic Delivery Systems

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John Woodruff

For cosmetic skin care products to be effective they need to be absorbed by the stratum corneum and remain on the site of application long enough to achieve the desired results. Following on from last month's article about sun protection this one will look at various ways of mitigating sun damage and at delivering such ingredients to the targeted area and controlled release systems that enable those actives sufficient time to be effective.

Sun damage is mainly recognised as the result of free radical formation by UVB and UVA solar radiation, which damages DNA and induces inflammatory responses. Uvaxine from **LibraGen** [INCI: Glycerin, polydatin glucoside] is described as a bio-active ingredient obtained by means of the enzymatic glycosylation of a natural plant stilbene, which activates the skin's own defensive systems. It is recommended that it be incorporated in make-up and sun protection products at from 0.2 – 4% and be applied before sun exposure. Trials suggest that it protects skin fibroblasts and reduces damage to DNA.

Also suggested for application before sun exposure to stimulate skin's defensive responses is Unisooth ST-32 from **Induchem**. It is described as is a balanced blend of active substances consisting of an extract from Tamarindus seeds, stevioside, pentylene glycol and water. Tamarindus Indica seed extract has shown anti-inflammatory properties in traditional medicine. Its polysaccharides have soothing characteristics and a capacity to protect against UV-induced damage. Extensive investigations by **Induchem** show that Unisooth ST-32 protects and soothes skin epidermis from external aggressions, protects Langerhans cells and increases synthesis of pro-immunity proteins in keratinocytes to boost skin defences and stimulate skin repair mechanisms.

Tego Cistus from **Evonik** provides DNA protection through its antioxidant capacity and also has anti-inflammatory properties. It is the polyphenol fraction isolated from Cistus incanus tauricus by aqueous/alcoholic extraction and delivered in microcapsules of maltodextrin. The active ingredients are gallic acid, syringic acid, quercitrin, isoquercitrin and rutin. Tests show significant reduction in sunburn cells when Tego Cistus is incorporated in sun protection products at 0.1 - 1%, based on the total composition.

If sufficient protection from UV radiation is lacking then sun-induced damage is likely to occur. Skin does have its own repair mechanisms and accelerating this process is the claim made for Unirepair T43 from **Induchem**. It is described as a complex containing high amounts of acetyl tyrosine and proline, a hydrolyzed vegetable protein extract and adenosine triphosphate (ATP) as an energy booster. Induchem suggests that Unirepair T- 43 is particularly effective in anti-aging compositions where acceleration in the skin repair mechanism is advantageous.

**Evonik** suggests that an effect of UVA damage is oxidative stress that requires an increase in cell metabolism but there is also a reduction the availability of ATP, responsible for providing skin cell energy. Tego Cosmo C [INCI: Creatine] is said to increase the availability of ATP, which is necessary for the synthesis of key proteins like collagen and elastin and enzymes responsible for protection mechanisms.

**Principium B.S.I.** is a Swiss company that provides active ingredients for cosmetic and pharmaceutical use. It suggests Honey Sun Flower [INCI: Pleurotus ostreatus extract, maltodextrin, pollen extract] for treating skin that has been exposed to acute stress linked to sun exposure. Its effective film forming activity helps to prevent further dehydration by water loss. In addition, inflammatory mediators are modulated and the skin is soothed and re-energised.

Pangenine Lolium from **Principium** is derived from the solvent free extraction of Lolium Perenne, harvested from a controlled source of pesticide-free crops. It claims 4-in-1 actions; skin nutrition thanks to essential amino acids; energy for the mitochondria, modulation of inflammatory mediators and reduction of the accumulation of oxidative mediators at tissue level. Heliomoduline [INCI: Gossypium hirsutum (Cotton) extract] from **Silab** is said to initiate the natural repair process of DNA by stimulating the expression of XPC protein. It also inhibits the production of UV-induced pyrimidine dimers thus reducing the erythema response of sun exposure.

Neuropeptides produced by nerve, skin and immune cells serve as preferential messengers to maintain skin homeostasis. Rupture of this equilibrium by external or internal aggression leads to physiological disorders such as inflammation, skin hypersensitivity and premature aging. **Lucas Meyer** offers Neutrazen as a soothing neurocosmetic based on three amino acids and a biomimetic lipopeptide. In vitro experiments demonstrate that Neutrazen is a modulator of cutaneous inflammation; it reduces the production of UVB-induced inflammatory cytokines and reduces sun-induced erythema and oedema.

Ultrasomes [INCI: Micrococcus lysate] from **Barnet Products** are targeted at post-sun exposure damage recovery and to improve the immune defence system. Ultrasomes are UV-endonuclease enzymes encapsulated in multilamellar liposomes. The endonuclease is prepared from *Micrococcus luteus* and the liposomes are formed from pure egg phospholipids. They are also said to stimulate the production of melanin by melanocytes in the tanning response following UV exposure. Barnet also supplies Photosomes, a plankton extract in liposome form, which is said to be activated by light to restore the DNA and immune system and slow the aging process.

Rutimine from **Res Pharma** [INCI: Rutin, lecithin] is offered as a free radical scavenger and DNA protector. It has antioxidant activity that is enhanced by the penetrating properties of the liposome and is suggested for anti-ageing products and after sun applications at a level of 0.5 to 2%. PhytoCellTec Solar Vitus from **Mibelle Biochemistry** is a powder based on the stem cells of a red grape that is tolerant to strong UV radiation. It may be added to sun protection and post-sun products to protect and repair epidermal cells stressed by UV radiation.

Sphingomyelin is one of the major component of the cell membrane. Under environmental stimuli sphingomyelin is degraded to ceramide. DS-Sphingomyelin from **Doosan** is said to protect skin from dryness and help maintain skin barrier homeostasis. It is also useful as a

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liposome stabilizer by increasing liposome rigidity. In-vitro and in-vivo investigations show that it improves the skin barrier and reduces TEWL. It also normalizes cell desquamation from the stratum corneum, preventing abnormal clumping of dead skin cells.

Abyssine 657 [INCI: Aqua, butylene glycol, alteromonas ferment extract] from **Lucas Meyer** is described as exopolysaccharides from extremophile living in deep sea hydrothermal vents. It reduces skin reactivity and discomfort as well as providing protection against UV-damage, allergic reactions and mosquito bites. It is said to soothe irritated and sunburned skin to reduce skin discomfort, dryness and flakiness. Aldavine from **Lucas Meyer** is a solution of Ascophyllum nodosum and Asparagopsis armata extracts to target pro-inflammatory mediators and protect micro-capillary integrity from environmental factors such as sunburn.

Liposomes and other related structures were covered in detail in **SPC, May 2013**. Although based on a core material encased in lecithin phospholipids Tinoderm Nanotopes from **BASF** are of smaller particle size and a different structure to liposomes. They are characterized by their specific unilamellar membrane consisting of cone-like and cylinder-like molecules. The alternating cone and cylinder sequence provides highly stable particles and further protects the encapsulated active. Additionally, this structure strongly resists molecules associating with membranes, such as surfactants or preservatives. Nanotopes have a particle size smaller than the inter-corneocyte (50 nm) lipid layer to provide fast and efficient transport through the skin barrier and are available with vitamins A, E and B5 as the core material.

Polymatrix 12AP from **Koda** is a gel formed from a highly cross-linked polyacrylate dispersed in a moisturising polyol/copolymer blend. It is a combination of water, glycerin, sodium acrylates/vinyl alcohol copolymer, sodium acrylic acid/MA copolymer, caprylyl glycol and 1,2 hexane diol. Its clathrate structure creates a moisture reservoir for sustained delivery when it is disrupted by shear on application to the skin. It also has a thickening action on emulsions and imparts a silicone-like skin feel.

MicroMatrix Fractile from **The Innovation Co.** is based on natural polysaccharides from corn starch forming a polymeric matrix structure with either an anionic or cationic surface charge. This structure functions as an active delivery system that forms a micro thin film. It retains actives delivering them slowly to provide a long lasting effect and silky smooth after-feel for several hours after application. MicroMatrix Fractile CAT is the cationic version and is ideal for topical applications intended to stay on the surface of the skin. MicroMatrix Fractile AN offers an anionic matrix structure, which is ideal for products intended to deliver actives deeper into the dermis.

**Ashland** market the well-known Lubragel series of moisturising gels and has recently launched a natural-based version that is Ecocert compliant. It is described as a cross-linked polysaccharide interbiopolymer complex of algin and xanthan with beta-glucan and glycerin. The Hyalu-Cage System promoted by **I.R.A** is based on the creation of a cage of hyaluronic acid that encloses the active principle. In this way the active is protected from the external agents and, thanks to the natural enzymatic degradability of the hyaluronic acid it is gradually

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released. The cross-linked hyaluronic acid used is of biotechnological origin and the gradual release of the active is due to the presence of hyaluronidase on the surface of the skin.

Microencapsulated products are small particles that contain an active ingredient or core material surrounded by a shell or coating. Particle diameters generally range from a few microns to a few millimetres and may be simple droplets of liquid core material surrounded by a spherical shell, or particles containing small droplets of core material dispersed in a continuous polymer shell matrix.

Agar is a natural polysaccharide, extracted from algae, able to form aqueous gels by natural cross-linking. Softspheres from **Kobo** use the properties of a cationic and amphiphilic copolymer to interact with active molecules by means of ionic bonds and hydrophobic interactions. The complex is too large to move through the agar matrix and the bonded molecule is thus trapped within the soft bead. When applied to the skin the bead is broken through shear forces and the internal active is released. There are numerous variations of differing size, colour and encapsulated active available from **Kobo**.

The Captivates HC encapsulates series [**was ISP and I think this is now Ashland**] is made up of a complex coacervate based on naturally derived polymers, which can contain a variety of lipophilic cosmetic ingredients. The Captivates GL encapsulates series are gelled polymers that form a hydrogel matrix, which can trap insoluble powders, oils and water-soluble actives. Their particle size varies from 500 – 1500 microns and they are used for visual impact and to impart feel and texture to products or to protect sensitive active materials from degradation before application.

Fusion Powders from **Sunjin Chemical Co.** are porous PMMA beads that can be loaded with active ingredients that will represent 40% of their total weight yet remain dry with a powdery feel. They are available with various actives preloaded including arbutin for skin whitening, adenosine for its anti-wrinkle properties and dipotassium glycyrrhizinate as an anti-inflammatory. Many others are available and their principal use is to add active ingredients to make-up powders. Also from Sunjin are Hybrid PMMA beads containing UV absorbers including BMDBM, which improves its stability. Hybrid PMMA beads sit on top of the skin, forming an invisible physical barrier against UV rays and can also be used on sensitive skin because the hybrid system eliminates the distribution of organic filter in the skin layers.

Another material supplied in powder form is DS-HydroCeramide 50S from **Doosan**. It is described as a water-dispersible ceramide powder in a solid liposome-like form. It contains 45% ceramide-3 and improves skin moisturising levels by reinforcing skin barrier properties and reducing TEWL.

Sprays are a form of cosmetic delivery system but they are normally limited to thin lotion systems. Volarest FL from **Croda** is a polymer supplied as an acidic emulsion which needs to be neutralised with a suitable base, such as sodium hydroxide solution or triethanolamine, to create a clear gel. The polymer architecture of Volarest FL [INCI: Acrylates/beheneth-25 methacrylate copolymer] has been optimised to create formulations with high zero shear

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viscosity. This means that flowable gels can suspend particulates and its shear-thinning rheology enables it to deliver a fine spray from a high viscosity cream. As Volarest FL exhibits pseudo-plastic and non-thixotropic rheology the small droplets of cream immediately reform on the skin or hair.

**Biosynthis** offers specialty microcapsules under the trade name Biopearl for long lasting effects. Encapsulated materials include perfumes, essential oils and anti-mosquito ingredients and UV filters, vitamins, caffeine and DHA are also available. The Biopearls can be used to impregnate clothing to provide Cosmetotextiles, According to the Bureau de Normalisation des Industries Textiles et de l'Habillement (BNITH), "a cosmetotextile is a textile consumer article containing durably a cosmetic product which is released over time" thus they can be considered as a cosmetic delivery system.

The concept of cosmetotextiles is not new. In the late 1980s, stockings with cyclodextrin-encapsulated fragrance were marketed in Japan and Hermès launched a scarf perfumed with encapsulated Calèche in Europe in 1995. More recently Wrangler launched its Denim Spa collection incorporating moisturising, circulation-boosting and cellulite-reducing "spa" treatments and lingerie brand Triumph added aloe vera micro-moisture capsules into its Light Sensation shapewear line. [Ref 1].

A French company called Lytess [Ref 2] launched slimming tights in 2003 and anti-cellulite products in 2005. It launched its first ready to wear cosmetotextiles in 2006 and entered into a partnership with L'Oreal in 2009 and in 2012 it launched a range of dermatotextiles. A Malaysian company called Laboratoire Skin'up offers slimming cosmetotextiles based on encapsulated sea kelp. The clothing items are very tight on the wearers so perhaps that is why the claimed results are achieved.

There was a symposium on the subject [Ref 3] in Paris, which was jointly sponsored by Interfilère and La Federation de la Maille et de la Lingerie following which the organisers published a seven page report. An article entitled "Development of Cosmetic Textiles Using Microencapsulation Technology" published in 2008 describes the technology in some detail. [Ref 4]

Cosmetotextiles can lead to unique innovations such as self-tanning swimwear and hair minimising tights to delay hair growth, however the technology is difficult. The products need to be efficacious and the cosmetic effect has to last through numerous wash and wear cycles. The active ingredients can be incorporated into textile fibres by chemical reaction, physical absorption and encapsulation.

Microencapsulation technology would appear to offer the most durable effect when impregnating clothing, ensuring a slow release and therefore providing a satisfactory performance. Microcapsules protect the active ingredients from the environment and release them during specific circumstances, for instance when they are physically broken by friction or pressure, when changes in pH or temperature occur or in the presence of water.

**Lipotec** offers Quiosels cosmetotextile lipid vesicles, a cationic controlled release system that is anchored to the fibre by electrostatic attraction. Encapsulated ingredients currently offered

can provide anti-ageing, firming, anti-cellulite, moisturising and hair growth delay properties. Lipotec claims that because of their similarity to biological membranes Quiosels show greater affinity for the skin than for the fabric, which facilitates the transfer of the active ingredients to the skin.

Lipocapsules from **Lipo Technologies** supply customised microcapsules for application to textiles. Selection of the appropriate shell material and inner core active ingredient then allows fabrics to be used for different applications. The shell material involves the precipitation of a synthetic polymer around a hydrophobic core material. The polymer may be gelatine, polyoxymethylene urea (PMU) or methoxymethyl methylol melamine (MMM) and the core material is selected according to the effect required. Capsule size ranges from 5-100 microns and they are offered as a slurry, wet cake or dry powder.

**Clariant** and **BASF** also offer materials for cosmetotextile applications and **Oat Cosmetics** are involved in a fabric softener project whereby colloidal oatmeal is incorporated to allow beta-glucan to impregnate the fibres. Impregnated non-woven wipes are also of textile-material but these are usually for single use so do not undergo washing.

In response to a query about cosmetic regulations **Intertek** confirmed that “Cosmetotextiles must conform to the requirements of the Cosmetic Directive as well as the governing textile regulations to guarantee safety and efficacy to the consumer.”

Finally, whatever the product it is most probably going to contain perfume. Emulsion de Parfum [INCI: Hydrogenated lecithin] from **Lucas Meyer** encapsulates perfumes until the capsule breaks, either by rubbing the skin, hair motion or with the natural reaction from skin contact, when the fragrance is released and intensified.

NOTE: Only the principal ingredients are listed under the INCI names and those interested are strongly advised to seek further information about composition and Ecocert compliance from the suppliers.

Ref 1: Source: Euromonitor International

Ref 2: <http://www.lytess.com/index.php/en/wat-inside/microencapsulation.html>

Ref 3: [http://www.knittingindustry.com/uploads/1939/Cosmetotextiles\\_Symposium.pdf](http://www.knittingindustry.com/uploads/1939/Cosmetotextiles_Symposium.pdf)

Ref 4: Cheng S, Y. Development of Cosmetic Textiles Using Microencapsulation Technology; RJTA Vol. 12 No. 4 2008

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[www.creative-developments.co.uk](http://www.creative-developments.co.uk)