

Hair Care Feature  
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John Woodruff

Considering that the hair visible on human heads consists almost entirely of dead protein a disproportionate amount of time and income is spent looking after it. First it has to be cleaned, then disentangled and combed, two relatively simple processes that can be taken care of using a shampoo and a hair conditioner. It is then that matters become complicated with owners wanting to bleach, colour, straighten, style and otherwise maltreat the hair that they have, safe in the knowledge that it will continue to replace itself, until one day it is realised this is not happening anymore.

**On average each strand of hair grows 10.5mm per month, which over the whole head equates to 35m per day or 12.5km per year [Ref 1].**

**Hair in good condition can absorb more than 30 % of its own weight of water.**

**Blow-drying and oxidative stress lead to the formation of reactive oxygen species (ROS) which oxidize and degrade the proteins of the hair surface and thus affect the structure of the hair**

Washing hair with shampoo would seem to be a straightforward process but a glance along the relevant shelves in any major store or pharmacy reveals just how many apparently different products there are. A basic product comprising sodium laureth sulphate (SLES) with cocamidopropyl betaine (CAPB) in water will effectively clean hair and it is doubtful that any other combination of surfactants will be as cost effective as the SLES/CAPB combination. It gives rapid and copious foam; is easy to thicken and is almost colourless and odourless and for these reasons it is still the most common system to be found in mass market products.

Adding botanical extracts makes the product easier to market and there are many ingredients available to further improve product characteristics however the starting point is to look at the surfactant system.

Despite the effectiveness of the SLES/CAPB system for various reasons alternative combinations are sought after. Some consumer groups do not like ethoxylates; some don't want sulphates; others would like to be thought natural and some would just like to stand out from the crowd. Alkyl polyglucosides did much to fill the gap, they are widely accepted as being "green" and there is plenty of advice on formulating with them available from their principal suppliers, **Cognis (now BASF)** and **Evonik**. Also **Dow Chemicals** has recently launched a 50% solution of decyl glucoside as Triton CG-50.

Sulfosuccinates are produced by the **EOC Group** and **Croda Europe** and Croda also supplies sarcosinates. Acyl lactylates from **R.I.T.A.** have good foaming characteristics and are suggested for use with alkyl polyglucosides. Amphoterics are generally added to improve mildness to standard systems and typical examples are amphoacetates and amphopropionates available from **Rhodia**. There are glutamates from **Ajinomoto**; sugar-based anionic surfactants from **Colonial** and surfactants derived from vegetable proteins from **Synerga**.

For those looking to be ever more natural there is Amaranth from **Arch Personal Care**, which is sodium cocoyl hydrolyzed amaranth protein and **Synerga** uses different mixtures of fatty acids and hydrolysed protein chains of different lengths to obtain anionic surfactants with detergent properties. **Paroxite** supplies a Quillaia saponaria extract with very good foaming properties and **I.M.C.D.** markets Zizyphus

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joazerio bark extract from **Soliance**. **Symrise** offers *Sapindus mukurossi* peel extract, which is recommended for personal cleansing products including shower gels and shampoos.

None of these surfactants can be considered new and most were described in greater detail in SPC September 2008. More recent introductions include Liposine Glyglu/R from **Biobasic Europe** and available through **Blagden** in the UK. It is a lipo-amino acid obtained from the acylation of coconut fatty acids with amino acids from rice. The resultant lipo-amino acid complex may be substituted for the primary surface-active agent in a shampoo and the foam obtained is said to be creamy, fine and stable. The Liposine product brochure contains a foam stability test, the results of which show that the foaming properties of Liposine are comparable with SLES and sodium coceth sulphate, and that it is better than lauryl glucoside. It is also very mild and may be used with SLES to reduce its irritation scores.

Amisafe AL-01 [INCI: Lauroyl arginine] from **Ajinomoto** is an amino acid based amphoteric surfactant derived from L-arginine and lauric acid. It is said to be ideal for very dry, damaged and unruly hair as it effectively binds to the hair to improve smoothness, hydration, shine and control. It is suitable for shampoos, conditioners and styling products with a recommended usage level of 0.2-5% in shampoos and 0.5-1% in hair conditioners and styling products.

**Cognis-BASF** is known for providing optimum mixtures of ingredients to provide particular properties; its Lamesoft Care is a mixture of PEG-4 distearyl ether, sodium laureth sulfate, distearyl ether and dicaprylyl ether, which demonstrates particularly strong performance for conditioning and protection against hair breakage when used in a shampoo.

Natural cleansing and foaming agents appeal to certain market niches and besides those previously mentioned **Pacific Sud** offers Ginger Shampoo. It is a clear viscous juice found in the mature flower heads of *Zingiber zerumbet*. It is rich in natural surfactants and is said to leave the hair soft with exceptional shine. It may be used as it is or mixed into shampoos and conditioners as an additive.

Known for its supply of glutamates and sarcosinates **BC Cosmetics & Food** uses various natural vegetable triglycerides to offer a number of amphoteric surfactants under the generic INCI name Sodium triglyceride amphoteric surfactants. The source materials include sweet almond, babuosa, cotton, olive and argan oils.

Argan oil is currently popular in hair and skin care products: it is pressed from the seeds of the *Argania Spinosa* tree and is composed primarily of unsaturated fatty acids and is rich in sterols. While its main use is in skin care **Aldivia** has argan oil as the basis of Viatenza Argan PO6 and PE8, which are argan oil polyglyceryl esters and argan oil PEG-8 esters respectively. These amphiphilic compounds are recommended as secondary surfactants and solubilising agents for shampoos and are available through **Surfchem** in the UK.

**Aldivia** also promote the use of oat beta-glucan as Avenacare. Through the formation of a natural film, Avenacare improves the tensile strength of hair, adding body and repairing damage caused by the elements or the overuse of chemicals in other hair care products.

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Utilising carefully selected combinations it is possible to formulate shampoos that will appeal to whichever market share is the target but additives are needed to further differentiate the shampoo compositions.

Based on natural materials Phytensol from **Lucas Meyer** is glycine soja (soybean) oil with phospholipids and it can be delivered in either a shampoo or hair mask base to relax and straighten frizzy hair. Also from Lucas Meyer and extracted from soya bean, Amisol Trio contains phospholipids, glycolipids, phytosterols and vitamin F and constitutes a natural source of these essential components present in all living cells. It is said to give the hair a pleasant feel, surface gloss and distinctly improved wet or dry combing properties and to reduce scalp irritation.

5-alpha Avocuta [INCI: Butyl avocadate] from **Expanscience** reduces excess sebum in skin and hair by inhibiting the 5-alpha reductase enzyme from converting testosterone into DHT, thus reducing stimulation of the sebaceous gland. In- vivo efficacy data shows it is ideal for greasy hair Recommended usage level is 0.5-2%. Another material with an inhibiting effect on the 5-alpha reductase pathway is Ajidew ZN-100 [INCI: Zinc PCA] from **Ajinomoto**, which when used at 0.2% - 1% has excellent anti-bacterial efficacy, in particular against *Melassezia furfur*, the principal cause of dandruff. Recommended usage level is 0.2-2%.

**Dr. Straetmans** is known for multifunctional cosmetic ingredients that combine basic cosmetic functions like hydrating, conditioning and masking with an antimicrobial profile. Dermosoft Decalact [INCI: Sodium caprinoyl / lauroyl lactylate] is based on a synergistic mixture of middle chain acyl lactylates produced from natural components. The antimicrobial efficacy of Dermosoft Decalact was optimised to act specifically against microorganisms that cause disorders like dandruff. It is anionic in character and is described as a naturally derived ingredient for antidandruff shampoos.

Protecting hair colour from fade through washing and exposure to sunlight is an area that generates a lot of interest. Syntran PC 5330 [INCI: Polyquaternium-91, polyacrylate 15] from **Interpolymer** is a multi-functional polymer with modified quaternary groups that make it substantive to hair. It inhibits the migration of molecules in and out of the hair shaft, thus impeding the process of dye loss. Syntran PC 5330 is recommended for shampoos and conditioners at a level of 3 – 5% and is said to deliver soft feel characteristics to hair and to help build viscosity in formulations.

Colour fade in sunlight is an oxidation effect and the use of antioxidants to inhibit the development of free radicals is proposed by various suppliers. **Mibelle** offers GSP-T as an antioxidant complex that combines water-soluble Swiss grape seed procyanidins and oil soluble natural tocopherol in a transparent, water-soluble form.

**Prodew 500** from Ajinomoto is described as a synergistic combination of amino acids and PCA that is almost identical to the composition of human hair. It imparts a powerful repair and restructuring of the hair follicle and the amino acid L-arginine works in synergy with sodium PCA to provide frizz control and to reduce colour fade whilst also providing moisture and hair shine. Recommended usage level is 0.5-2%.

Additives for shampoos are also generally suitable for hair conditioner compositions and often have better and longer lasting contact with the hair shaft as such products

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are designed to be substantive to hair. The restriction will be if there is any incompatibility with the cationic nature of most conditioners. It is also noticeable that many functional ingredients initially developed for skin care applications are also proving suitable for use in hair products.

One such material is DayMoist CLR from **CLR Laboratories**. This mixture of hydrolysed corn starch and beta vulgaris extract is a well-established skin care ingredient of natural origin; it has a 24 hour moisturizing effect after just one application on skin, elevating the concentrations of the NMF in the stratum corneum. Now it has been found that if hair tresses are treated with a 1% solution in water it will protect hair from heat and colour fade as well as improve its moisture content and wet combability.

Hydrolyzed Quinoa is available from **Tri-K** under the trade name Quinoa Pro X that confers film forming and moisture retention benefits typical of proteins, and is proven to provide substantivity and penetration of the hair for damage protection and control when applied as a 1% aqueous solution.

Similarly Aquarich from **Rahn** contains polysaccharides and amino acids from Avena strigosa seed extract and lecithin. When used on the hair it has a repair effect and the degree of damage to the hair and the surface structure of previously damaged hair is reduced. Recommended usage level in hair products is 0.2-2% and it can be used in shampoos and conditioning products.

Haiaqueouster DCS from **Kokyo Alcohol Kogyo** is ethoxydiglycol succinate; a water-soluble ester with good anti-static and hair conditioning properties.

Polyfluoroesters (PTFE) are well known additives to cosmetic products but also have applications in hair care. The Fluoropure Ultrafine series from **Shamrock Technologies** are 50% PTFE dispersions in water with soft, spherical submicron particles that adhere to hair and have good conditioning applications and also add volume and shine with UV and colour protection. Both Haiaqueouster DCS and Fluoropure PTFE dispersions may be used in shampoos and conditioners.

Amidet APA-22 [INCI: Behenamidopropyl dimethylamine] from **Kao Chemicals** is a non-ionic ingredient that acts as a cationic conditioning agent if used at acid pH. It can be incorporated in shampoos and cationic conditioners and the pH should be adjusted with lactic acid to an optimum pH 4.25. Terraquat BD [INCI: Bis-(ethyl PPG-3 behenate) dimonium methosulfate, behenamidopropyl dimethylamine] from **Croda Europe** is a biodegradable hair conditioning agent with an excellent aquatic toxicity profile that delivers all the performance of traditional conditioning agents. It shows great formulation versatility, being suitable for use in shampoos, conditioners and styling agents.

Sensomer CT-250 and CT-400 polymers [INCI: Cassia hydroxypropyltrimonium chloride] from **Lubrizon** are multifunctional polymers derived for use in conditioning shampoo formulations. It is claimed that Sensomer™ CT-250 and CT-400 polymers are more efficient silicone deposition aids than traditional cationic conditioning polymers, such as PQ-10 and cationic guar. This enables the use of lower levels of silicone and cationic polymer to deliver equivalent or better overall conditioning performance.

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KeraDyn HH [INCI: Bis [ethyl (isostearyl imidazoline)] Isostearamide] is a new material from **Croda Europe** designed to improve the movement of damaged hair. When hair is subjected to chemical processes such as bleaching, oxidation dyeing or hair straightening this results in a high level of friction between the hair fibres. KeraDyn HH reduces this friction and improves fibre alignment so that hair regains its natural movement. The way this was tested makes interesting reading and details are available from Croda.

Peptides are proving to be very popular in skin care products and are also effective in hair products designed to improve tensile strength and elasticity. Two products from **Provital** illustrate this approach; the first is Kerarice; a hair care active obtained from rice which is rich in amino acids and biofunctional peptides, polysaccharides and phytic acid. Ex-vivo data shows improvement in the tensile strength of the hair, keratin protection and protection of the lipid layer and it also protects hair from colour fade in sunlight. The other material is Keratrix 7332, which contains biofunctional peptides and glutamic, arginine and aspartic amino acids extracted from *Ceratoniasiliqua* (Carob) seeds. They are incorporated into Provital's new technology, Matrix Plus; a three dimensional network which allows controlled release of the actives and being positively charged, Matrix Plus forms a protective film around the cuticle.

Panthenol is arguably the most common additive to be found in both shampoos and hair conditioners. It has proven moisturising effects on hair and can improve hair strength and shine. Lipobelle S100/PA contains panthenol encapsulated in the **Mibelle** CDS or cationic delivery system in which the actives are encapsulated into liposomes or nanoemulsions containing stearylamine. These vesicles are positively charged and adhere to the negatively charged hair surface even in a rinse-off application. Mibelle's CDS is also used to encapsulate UVB/UVA absorbers to protect hair against colour fade.

CP Sweet Blue Lupin Peptides from **Ceapro** is a 10% solution of hydrolysed lupin seed extract in water plus 0.90% glucanolactone, which is a natural sequestering agent. It imparts thin films onto the hair shaft, but also demonstrates excellent penetrative properties giving it the ability to maintain hair colour. Melscreen Black, Red and Gold are three products from **Chemyunion** that are based on plant extracts that have antioxidant properties to protect hair colour from peroxidation combined with extracts that maintain the hair colour.

Blue Seakale HC from **Biotech Marine** is an extract of *Crambe maritima* and is suggested for colour protection of hair. It hydrates and protects the hair and scalp from environmental stress and hot blow-drying and it protects and maintains hair colour when used at 1% or more.

Phytoserum [INCI: Algae extract, Macrocystis Pyrifer] from **Koda** is said to provide a long lasting, lustrous finish to the cuticle, by allowing the hair to retain moisture. Sanicapyl is a new natural complex from **Laboratoires Sérobiologiques** to treat major scalp disorders. It is based on extracts of black pepper berries and *Inga alba* bark and it not only reduces dandruff but also regulates sebum production and soothes an itchy scalp. It is claimed to moisturise the scalp and leave hair shiny and soft. It is suitable for all hair types and can be used in shampoos, conditioners and lotion formulations.

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Polyquaternium -6 and Polyquaternium-22 are two materials from **DSM** with excellent conditioning properties. Marketed as Tilamar Quat 640 the polyquaternium-6 is a low viscosity polymer providing handling and processing advantages for use in cosmetic applications. The extreme and superior wet combability of Tilamar Quat 2240 [INCI: Polyquaternium-22] results in excellent sensorial attributes for both wet and dry hair. Both materials are suitable for shampoos or conditioners and both show excellent wash out capabilities and do not build-up on the hair, even with repeated use.

A material that, because of its cationic nature, can only be added to conditioning formulations is Epiprotectyl UV from **Rovi**. Containing the UV absorbers octocrylene and butyl methoxydibenzoylmethane in a vehicle comprising inulin lauryl carbamate, caprylic/capric triglyceride and sucrose laurate with behentrimonium chloride it is very substantive to hair. It enables a high level of UV filter to adhere to the surface forming a continuous non-penetrating film which offers good resistance to washing.

*Melassezia* is a yeast strain that feeds on the triglycerides present in sebum and excessive sebum production results in proliferation and growth of these microorganisms. Increased degradation of triglycerides yields larger amounts of free fatty acids, especially oleic acid and these by-products produce scalp irritation, which in turn stimulates mitosis in the basal layer.

Trikenol from **Provital** is a combination of standardised manuka concentrate (*Leptospermum scoparium*) and willow extract (*Salix alba*). In-vitro tests show that Trikenol inhibits the proliferation of *Melassezia globosa*, a yeast that causes dandruff. Trikenol also reduces inflammation caused by the production of prostaglandins and it inhibits the production of sebum, making it useful for use in products for oily hair.

From Ajinomoto **CAE** [INCI: PCA ethyl cocoyl arginate] is described as an extremely mild cationic surfactant derived from natural sources, with excellent anti-microbial data, particularly against *Melassezia furfur*. Recommended usage level is 0.05-0.2% in hair conditioners.

Adandrine from **Silab** is an extract from pomegranate peel and is a natural anti-dandruff ingredient. It is claimed to combat microbial invasion and restore the balance of the epidermal differentiation process. Thanks to its anti-inflammatory properties, it reduces significantly scales and itching and improves the general state of the scalp.

Emulsense HC from **Innolex** is a cationic conditioning aid based on Brassicyl isoleucinate and brassica alcohol that should be neutralised with a weak base such as arginine to pH 3.5 – 5.5. Unlike many cationic materials it is deemed to be natural and is Ecocert approved. To escape entirely from quaternary compounds **Beraca** suggests the use of Beracare BBA. It is Pentaclethra macroloba seed oil and is rich in behenic acid (C22:0), a long chain acid that promotes hair conditioning. It imparts a smooth feel to hair and skin and will improve wet combability and hair shine. It helps to promote viscosity in emulsions and is compatible with cationic agents if further conditioning is required.

EcoSmooth Silk Conditioning Polymers [INCI: Ethylene/octene copolymer, ethylene/sodium acrylate copolymer] from **Dow** are non-cationic polyolefins dispersed in water with an acrylic-based polymer dispersant. EcoSmooth Silk is said

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to provide equivalent conditioning to silicone-based materials and it provides volume to hair and improves wet and dry combability.

Rep'Hair from **Solabia** is Behenyl / stearyl aminopropanediol esters and is described as a ceramide-like molecule. It is obtained by a green chemistry process without solvent, from two saturated vegetal fatty acids, behenic acid and stearic acid. It is said to restructure and strengthen hair and to improve hair gloss and can be used at 0.20% in leave-on and rinse off hair conditioners.

Dermofeel® P-30 from **Dr Straetmans** combines natural glyceryl monooleate with pyrrolidone carboxylic acid (PCA) to attach to the hair's cuticle and to renew the lipid layer that has been washed away by hair treatments. Like classical conditioning agents, it reduces the combing resistance in wet hair. Glossamer L6600 from **Tri-K** is a natural polymer derived from the copolymerisation of purified vegetable oils from *Brassica campestris* and *Aleurities fordi*. It is an unsaturated complex ester, is light in colour and odour and it is claimed to add moisture and gloss to hair and to improve resistance to colour fade.

There are many oils and butters said to improve shine, combability, detangling and smoothness of hair. Activeshine Amazon from **Chemunion** [INCI: Orbignya speciosa kernel oil, astrocaryum murumuru seed butter] is described as a natural sensory modifier for hair. Miraceti 100V [INCI: Cetyl esters] from **Laserson** is said to have better spreading properties than many oils and to effectively deposit on the hair.

**Greentech** supply soft butters from Inca Inchi and also from Bagura, both said to be rich in EFA's and with nourishing & protective benefits. **Natural Plant Products** supply Daikon Radish Oil described as a natural emollient derived from the seeds of *Raphanus sativus*. Its fatty acid composition distinguishes it from other natural oils and it has a delicate, non-oily feel. It is suggested as a potential replacement for Jojoba oil.

**Natpure Feel-M ECO** is an optimised blend of functional esters and fatty alcohols derived from coconut that is designed to provide shine and condition to the hair. It is said to impart a luxurious silky feel, smooth the hair cuticle and help in detangling hair. It is suggested as a replacement for silicones in "natural" shampoos and conditioners.

Trichomega from **Cobiosa** is extracted from the *Sacha Inchik* nut growing in the Amazon forests and it contains one of the highest amounts of polyunsaturated fatty acids (PUFA) among all oily seeds used for human consumption. It reaches an average of 48% of alfa-linolenic acid (Omega 3) and an average of 37% content of linoleic acid (Omega 6). Additionally it contains approximately 8% of oleic acid (Omega 9) and has a high concentration of tocopherols. It is said to make the hair more resistant to breakage and split ends

Prior to the use of cationic surfactants, which are the basis of the majority of modern conditioners, vinegar was used as a rinse after washing the hair. **Cosmetochem** has a range of fruit and vegetable vinegars under its Herbasol trade name. These include raspberry, blackberry, peach and apple plus rosemary and rice and customised vinegars may be available on request.

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Itchy scalp is a problem for many; whether caused by a reaction to hair products or a physiological cause. Defensil from **Rahn** [INCI: Octyldodecanol, Echinium plantagineum seed oil, Cardiospermum halicacabum flower/leaf/vine extract, Helianthus annuus (Sunflower) seed oil unsaponifiables] is recommended for hair care products for sensitive scalps or for scalp treatment after using aggressive treatments such as, hair dyes, perms and bleaching. Defensil is claimed to help prevent the main stages of inflammation; pain, itching, redness, swelling and heat and tissue damage. Recommended usage level is 1-5%.

Grey hair affects nearly everyone sooner or later and is not usually greeted with enthusiasm when it first starts to appear. Melitane from **Unipex** contains acetyl hexapeptide-1, a biomimetic peptide obtained from natural amino-acids. Melitane stimulates melanin synthesis by the melanocytes of the hair bulb and also favours melanin transfer from melanocytes into the keratinocytes that will constitute the hair shaft. Thus it significantly decreases the number of white and low pigmented cells and increases the number of moderate and highly pigmented cells in hair bulbs.

None of these ingredients are of use if a person has suffered complete hair loss. In order to delay the onset of baldness various ingredients are suggested. Only the hair bulb actively grows cells; they are very active and an optimal energy supply by mitochondria and an adequate availability of nutrients is essential for healthy and shiny hair. According to **Mibelle**, topical application of Lipobelle DN CoQ10 delivers coenzyme Q10 in a nanoemulsion that dramatically enhances the penetration of coenzyme Q10 into the hair follicle and rejuvenates aging hair follicle cells by enhancing mitochondrial energy production

Zymo Hydroxysteroid Dehydrogenase Complex [INCI: Sodium bicarbonate, maltodextrin, hydrolysed keratin, hydroxysteroid oxidoreductase] from **IRA Laboratories** contains an enzyme specifically designed to help stop hair loss caused by androgenic alopecia. The enzyme 3- $\alpha$ -hydroxysteroid dehydrogenase works by catalysing the degradation of DHT in the hair follicle. In vivo test data available from IRA shows hair length and number of hairs to increase over a 6 month test period compared to placebo.

Capixyl is a new active ingredient from **Unipex** for reduction of hair loss and stimulation of hair growth. Capixyl inhibits the 5-alpha-reductase enzyme by the action of its active component extracted from Trifolium pratense (Clover) flower and stimulates protein synthesis in the extracellular matrix by the action of acetyl tetrapeptide-3, which stimulates hair growth and enhances the anchoring system of the hair bulb. This increases the anagen/telogen ratio so that more hair remains in the growing phase with a corresponding reduction of hair in the resting phase. Use level is 1-5% depending on the application.

Based on *in-vitro* testing, Capauxein, a hydrolysed corn protein material from **ISP-Vinscience**, improves the expression of proteins involved in cellular adhesion such as fibronectin, laminin-5, and  $\beta$ 1 integrin, to help boost cell communication and, in turn, help strengthen the hair fibre. Capauxein helps stimulate markers that may affect growth and vitality and based on the *in-vitro* hair growth model, Capauxein may help boost hair growth.

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Also from **ISP-Vinscience**, Protectagen is based on hydrolysed rice protein and *In-vitro* tests show that it may help optimise the hair growth cycle. The third material from ISP-Vinscience is Dynagen, an aqueous/glycolic solution of hydrolysed yeast protein that boosts proteins that influence follicle development during the anagen phase. The developing fibre interlocks with the inner root sheath which keratinizes and builds additional layers of structural support around the growing hair, resulting in stronger, healthier-looking and more vibrant hair strands

**Natural Solution Co.** offers a hair growth stimulant trade named Sangmodan with no less than eleven natural extracts for preventing hair loss and scalp care. It was co-developed with Hyangkinara, a traditional Korean medicine clinic and further details are available from Unifect in the UK.

The suppliers or their distributors of all the materials mentioned in this feature have supplied full INCI listings and data to support the claims made. For more information those interested should contact the manufacturer or its agent direct.

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