

## Hair Care Feature

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John Woodruff

Hair is an area of great interest for anyone involved in the cosmetic industry. It needs washing, detangling and combing; it benefits from conditioning and its appearance can be changed by styling and colouring. Many owners of hair want it straightened, others want it wavy; many want it to have more volume, for it to be less greasy, better moisturised and, particularly men, want more of it. All these possible treatments added up to a staggering \$80+ billion US dollars world-wide industry in 2014.

The hair cycle is a period of growth termed the anagen phase, during which it grows approximately 13 mm per month and lasts an average of 3-5 years. This is followed by the catagen phase that lasts about ten days and then the hair follicle rests for about three months. This is the telogen phase during which existing hair falls out before the growth cycle restarts. Each hair follicle is independent and goes through the growth cycle at different times and a healthy head of hair loses approximately 80 hairs per day.

However, this is not the case for everyone and hair loss, or alopecia, is commonly seen in middle-aged men as male-pattern baldness or androgenetic alopecia and most men have some degree of hair loss by their late thirties. The most frequent cause of hair loss is the testosterone derivative, dihydrotestosterone (DHT), which is responsible for a suppressive effect exerted on the hair follicles. There are other causes that affect both men and women such as stress, a dysfunctional thyroid gland, pregnancy, radiotherapy and chemotherapy but hair growth generally recovers with time.

Treating hair loss is a fine line between cosmetics and pharmacy. The NHS web site [<http://www.nhs.uk/conditions/hair-loss/Pages/Introduction.aspx>] names two possible treatments. Finasteride is available on private prescription and comes as a tablet taken daily. It works by preventing testosterone being converted to dihydrotestosterone that causes the hair follicles to shrink.

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Blocking its production allows the hair follicles to regain their normal size and studies have suggested finasteride can increase the hair count.

The other named treatment is minoxidil, which is applied daily as a lotion and is available from pharmacies without a prescription. It's not clear how minoxidil works, but evidence suggests it can cause hair regrowth in some men. Both treatments take several months for benefits to become apparent and hair loss will continue if treatment is discontinued.

A brief patent search discloses several ideas, which may be applicable to cosmetic treatments claiming to reduce hair loss. USP 8,952,060 granted in February 2015 claims a composition for preventing hair loss or for stimulating hair growth based on the properties of valproic acid and its salts. The patent suggests that sodium valproate functions as a GSK-3 $\beta$  inhibitor, stabilising beta.-catenin in hair stem cells, and that it controls cell differentiation and growth. The applicants claim the composition may prevent loss of existing hair, improve its condition and form new hair by activating dermal papilla cells, thereby inducing hair growth.

USP 8,932,567 granted in January 2015 claims methods and compositions for stimulating the growth of hair by application of a lotion that includes bimatoprost and minoxidil, which it suggests, have a synergistic activity. It is said that a mixture of 0.03% bimatoprost and 5% minoxidil increases the rate of hair growth when compared to bimatoprost or minoxidil, alone. The patent also discusses other types of hair loss and possible approaches to improving hair growth.

An ingredient suitable for cosmetic preparations based on preventing testosterone being converted to dihydrotestosterone to reduce hair loss is Capixyl from **Lucas Meyer**. It is a complex of a biomimetic peptide [tetrapeptide-3] combined with Trifolium pratense (Clover) flower extract for

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stronger, thicker and fuller hair. Capixyl has a direct action on 5 $\alpha$ -reductase which modulates dihydrotestosterone (DHT) to help prevent hair miniaturisation and improves ECM proteins integrity in dermal papilla for better hair anchoring. Capixyl also reduces damage caused by inflammation, thus giving fuller, thicker and healthier looking hair, claims Lucas Meyer.

Zymo Hydroxysteroid Dhydrogenase Complex from **I.R.A.** is a complex of the enzyme hydroxysteroid dhydrogenase with maltodextrin and keratin hydrolysate mixed with sodium bicarbonate as inert carrier and pH stabiliser that is specifically designed to inhibit hair loss by androgenetic alopecia. The hydroxysteroid dhydrogenase enzyme is produced by the microorganism *Pseudomonas testosterone* and it metabolises DHT. By encapsulating this in maltodextrin it is available for sustained release. The keratin hydrolysate is a mixture of amino acids, which are the substrates employed in keratin synthesis and their availability is therefore essential to support hair growth.

Keratin makes up more than 90% of a strand of hair, which is a fibrous protein rich in sulphured amino acids, minerals and oligo-elements. Hair strength depends on its structure which is defined by bonds formed between sulphur atoms. **Solabia** suggests that its Cressatine, an active ingredient obtained as an aqueous extract of watercress (*Nasturtium officinale*) and Indian cress (*Tropaeolum majus*), stimulates and prolongs hair growth and strengthens hair from the roots. According to Solabia, Cressatine provides the elements needed to produce keratin for solid, well-structured hair and helps initiate hair regeneration with the release of KGF (Keratinocyte Growth Factor). KGFs influence hair shape and also its strength and the length of the growth phase is increased through KGF production.

Also from **Solabia**, Kerastim S, [INCI: Tetrasodium disuccinoyl cysteine], slows down hair loss and increases hair density by increasing keratinocyte

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metabolism while also allowing the production of a well-structured keratin for hair. This increase in metabolism is supported by an in-vivo study, which shows that 5% usage results in a reduction of hair loss in 82% of cases and an average 5% increase in hair density.

Akosky Azuki from **Akott** is a cell-communicating active derived from fresh sprouts of mung bean and red clover [INCI: Vigna radiata sprout extract, Trifolium pratense sprout extract]. Akott suggests that the main cause of hair loss is lack of communication between different types of cells in hair follicles and the negative effect of DHT on the hair follicle. Mung beans contain flavonoids, some of which are key inhibitors of 5 $\alpha$ -reductase, but its principal function is to counteract the negative properties that DHT has on hair follicles by stimulating positive growth factors and genetic messages. Unlike other hair growth actives, it works on promoting both the anagen and telogen phase.

According to **Lonza** hair follicles have very high rates of metabolic activity and studies of aged follicles often find inadequate capillary circulation directly to the follicle suggesting that the resultant lack of nutrient flow may be a contributory factor in the thinning of hair with age. ProCircul8 is an aqueous/glycolic complex containing Visnaga vera, which is known to contain a powerful microcirculation stimulant called visnadine, The molecule acts on the smooth muscles surrounding the micro-capillaries of the skin causing them to relax and open. By increasing microcirculation in the scalp, enhanced oxygen and nutrient delivery to the root of the hair is able to occur. In addition it contains betaine that strengthens hair and superoxide dismutase to protect hair colour from solar damage.

Anacryn from **Naturalis Life Technologies** is claimed to slow down the process of hair loss and improve the health of hair and scalp by reducing the initiation time of hair growth and increasing the population of hair in the anagen

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phase by up to 50%. Based on Ayurvedic medicine it is a glycolic extract of Eclipta prostate enriched with wedolactone, which slows down excessive hair loss, stimulates hair re-growth, protects the hair bulb and improves hair strength.

Developed as an anti-hair loss and detoxifying agent for use in hair treatment products by **I.R.A.** Nucleo Trico-Hyal uses cross-linked hyaluronic acid for the slow-release of cosmetic active ingredients. This entails the creation of a hyaluronic acid cage that encloses the active ingredients, thereby protecting them from external agents. The natural enzymatic degradability of hyaluronic acid permits the gradual release of the active ingredients over time, making them bioavailable for a prolonged period. Its complete INCI listing is water, sodium hyaluronate crosspolymer, Oleae europea fruit extract, sodium chloride, alcohol, cytidine monophosphate, disodium uridine phosphate and adenosine phosphate resulting in an ingredient that is claimed to be an active anti-ageing complex that improves hydration and cellular trophism, providing essential active ingredients to protect hair from free radicals and oxidative stress.

Vital Hair & Scalp Complex from **Lonza** is a combination of alpha hydroxy acids, Camellia sinensis extract, trimethylglycine, hexapeptide-11 and antioxidants. The a-hydroxy acids promote cell renewal on the scalp, which helps clear the follicles of dead cells, allowing more room for thicker hair growth. The acidic nature of Vital Hair & Scalp Complex, ensures that hair proteins are kept hard and more resistant to breakage and isoflavones in green tea extract protect the scalp from both oxidative stress and UV radiation.

Hexapeptide-11 is a bio-fermented peptide that upregulates key genes responsible for collagen production and important extracellular matrix components such as hyaluronic acid and the betaine encourages collagen production and strengthens hair.

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Sphingony from **Evonik** is a sphingolipid, based on a fermentative production process of yeast to yield a naturally occurring, skin-identical molecule termed sphinganine. Particularly with androgenic alopecia, Sphingony targets hair loss by inhibition of  $5\alpha$ -reductase and strengthening the hair follicle by providing it with proteins and ceramides. An in-vivo study involving 96 men with diffuse, non-health-related hair loss and fine and lifeless hair over a 16 week period showed that Sphingony effectively improves hair quality and scalp health, which eventually leads to a reduction in hair loss.

Biosil Basics from **Biosil Technologies** are three unique ingredients obtained by the reaction of a silicone and an amino acid that provide effective ways to optimise hair care formulations. Biosil Basics A-30 contains the amino acid, arginine that is converted to nitric oxide in the body, which can increase blood flow and stimulate hair growth. Biosil Basics DL-Methionine-30 contains the amino acid, methionine, which is said to retard pre-mature hair loss and also to improve the texture and quality of hair. Biosil Basics L-Cysteine contains cysteine that is able to create disulphide bridges and this ingredient is claimed to increase hair volume and provide conditioning for damaged hair.

DermaPep Papanagen from **Miwon** is myristoyl dipeptide-13 for anti-hair loss and hair-growth stimulation. It is supplied as a near-white powder or as an oil-soluble liquid in dipropylene glycol. In-vitro studies show that DermaPep Papanagen prolongs the anagen phase and delays the catagen phase by promoting proliferation of dermal papilla cells, fibroblasts, and keratinocytes and by increasing melanin production. In-vivo tests show that it inhibits hair loss and strengthens hair and there is no irritation or sensitisation.

From **Ennagram** comes Ennacompex 260, a multi-component botanical complex especially intended for shampoos and lotions for the prevention and treatment of hair and scalp disorders including dandruff, itching, and hair loss.

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It comprises a synergistic blend of white nettle, pine, burdock, chamomile, rosemary, ivy, arnica, watercress and garlic extracts that is claimed to regulate the sebaceous glands, to calm the scalp, soothe inflammation and relieve itching. Particularly rich in sulphur derivatives, garlic and watercress are powerful antiseptics and hair-growth stimulants and the flavonoids found in ivy and arnica stimulate the micro-circulation and thus favour hair growth while reducing hair loss.

Linoleic acid comprises about 40% of the oil content of sunflower (*Helianthus annuus*) seeds, which also contain phospholipids and oleic acid. The cortex is the major part of the hair and it provides strength, elasticity and both the colour and texture to hair. Its lipidic matrix acts as a cohesive cement but this becomes degraded through loss of cuticle and the generation of free radicals, which result in lipid peroxidation. **Lucas Meyer** has concentrated the linoleic and phospholipid content of sunflower oil to create Sunflohair that is able to compensate for the lipid loss by penetrating the hair fibre to restore the lipid matrix and return hair to its natural beauty

**The Kahai Company** of Columbia has won awards for sustainability and innovation for generating incomes for peasant and indigenous families within conflict zones. It is planting fast growing Cacay trees in areas of the Amazon that have suffered deforestation in Columbia. After three to four years its nuts are harvested and the oil extracted through a process that preserves all its properties and benefits. Kahai oil contains up to 75% linoleic acid and is reported to help unblock pores and hair follicles and to stimulate hair growth. Kahai oil is a “dry” oil that is rapidly absorbed by the scalp and has a mild nutty scent that rapidly fades.

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Through its subsidiary **Vincienc**, **Ashland** markets a group of ingredients under the title BiotHAIRapy. Described as a family of nature-based ingredients for leave-in systems they target the mechanics of hair aging and support natural follicle and strand organisation in ways that improve the appearance of hair. These biofunctional ingredients include Capauxein, based on hydrolysed corn protein that may help increase hair length by encouraging growth. Chromafend is hydrolysed linseed extract that increases the melanin in the hair cortex while Dynagen is a hydrolysed yeast protein that provides benefits for stronger, thicker, healthier hair. Pisum sativum (Pea) extract is the active in Procataline that is said to encourage catalase expression in hair follicles and preserve the melanin content of the cortex and the hair follicle may be protected from UV damage by the hydrolysed rice protein content of Protectagen.

**Cobiosa** produces a number of active ingredients of natural origin that are claimed to retard hair loss. Glycoenergizer Hair comprises glycogen in aqueous/glycolic solution. Glycogen is a combination of glucose molecules and is found in the lower part of the hair follicle. It is the energy source for protein synthesis during hair growth and **Cobiosa** suggests that by providing a ready source of glycogen it assures the availability of energy at the active growth phase of the hair follicle with a stimulating effect on hair growth.

Hairdensyl Complex from **Cobiosa** acts as a hair growth promoting agent. It is a marine and botanical multi-functional complex based on soluble collagen, a honey extract, sodium PCA, hydrolyzed elastin, serine and glycogen. It is promoted as a hair treatment to repair and strengthen hair structure, supplying the hair with substances for external as well as internal use to increase its volume and improve the vitality of hair follicles in the scalp to stimulate new hair growth.



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A third material from **Corbiosa**, which combines inhibition of the 5 $\alpha$ -reductase enzyme with an active ingredient to help modulate sebaceous secretion and excretion is Seboreductyl. Containing extracts of hydrolysed yeast and *Fomes officinalis* (mushroom) and pyridoxine, niacinamide, panthenol, allantoin, threonine and biotin it also works as a natural astringent and cleanser to ensure a healthy scalp.

Ensuring a healthy scalp is fundamental to hair care and **Dr Straetmans** suggests Dermosoft Decalact [INCI: Sodium caproyl/lauroyl lactylate] for this application. It is described as a natural and effective active derived from sugar beet that is effective against gram positive bacteria and yeasts including *Melassezia furfur*, a cause of dandruff. It is a viscous liquid that is anionic in character and is most effective at pH 5.5.

A novel treatment for dandruff is ImerCare 90P from **Imerys**. It is a natural mineral scrub bead made from a volcanic glass called perlite, which expands like popcorn when heated. These structures are then milled to give broken spheres that provide soft exfoliation to help remove dandruff from the scalp. It can also boost foaming and give a creamier lather and luxurious skin feel, making it ideal for anti-dandruff shampoos.

Repeated washing and brushing of hair can irritate the scalp and dry out the sebum that keeps hair and scalp soft and moisturised. According to **Lucas Meyer** the anti-irritating properties of phospholipids present in its Amisol Trio soothes scalp itching. It is also able to moisturise the scalp by reinforcing skin barrier function. Amisol Trio [INCI: Phospholipids, glycine soja (soybean) oil, glycolipids, glycine soja (soybean) sterols] can be added to shampoos to provide a conditioning action by smoothing hair cuticles.

Providing shampoo with conditioning properties led to the 2-in-1 types containing silicone derivatives. An alternative to silicones is Yogurtine from

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**Givauden** and two varieties are available. The original version consists of selected milk fractions: whey, whey concentrates and non-fat dry milk that are fermented with the yogurt bacteria *Streptococcus thermophiles* and *Lactobacillus bulgaricus*. Introduced as a vegetable alternative is Soy-Yogurtene derived from soybean. Either version may be added to shampoo at 1% to improve lather and make the hair softer and more manageable. If added at 0.2% to a cream conditioner it is said to improve hair softness and curl definition.

An alternative to phenyl trimethicone and other silicone-based additives to give shine to hair is Glossyliance from **Soliance, now part of Givauden**. It is a blend of natural extracts from *Saccharum officinarum* (sugar cane) and Citrus limon (lemon) peel with lactic, citric and malic acids in aqueous solution. Test results from both ex-vivo and in vivo tests are available that show a significant increase in hair shine and hair softness with a dose dependent effect starting at 3% when applied from a shampoo.

Combining hair strengthening with conditioning action is the claim for Ceramide II from **Soliance/Givauden**. Ceramide II is one of the lipids that produce the multilamellar layers of the stratum corneum barrier. It is a nature-identical molecule based upon the sphinganine group, which has been identified in natural hair lipids. It positively affects hair strength and resistance to damage by helping keep the cuticle in place and helping to maintain a smooth hair shaft. It is available as a lipid-soluble powder or blended with PEG-7 glyceryl cocoate and PEG-60 hydrogenated castor oil to give a water-dispersible liquid that may be added to both shampoos and conditioners.

Traditionally hair conditioners have been based on cationic surfactants because of their substantivity to hair and their anti-static properties. Necon LO [INCI: Dimethyl lauramine oleate] from **Alzo** is described as an innovative cationic

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complex that has excellent spreading characteristics on the hair. The cationic nitrogen affixes itself to the hair whilst the long lipophilic chain forms a barrier, which reduces moisture loss. This leads to long-lasting emolliency and moisturisation, even through multiple washes and leaves the hair soft and manageable. Also from **Alzo**, Necon LO 80 [INCI: Lineoleamidopropyl dimethyl amine dimer dilinoleate] is a patented, cationic, oil-soluble conditioning agent whereby a tertiary amine is complexed with a long chain fatty acid to provide a material that is extremely substantive and that improves wet combing and detangling and provides sheen and lustre to hair.

**Dr Straetmans** offers a number of hair conditioning materials derived from potato starch or cassava under its Amylomer trade name. The starch bases allow various individual modifications but overall they have low substantivity, give effective performance and are synergistic with traditional conditioner actives and formulations. They vary by their degree of quaternisation and molecular weights and some grades have additional hydroxyalkylation to ensure their biodegradability. A brochure is available from the suppliers that describes their different properties.

Also based on potato starch and available from **Dr Straetmans** is Symbio Quat that is a patented combination of two very different molecular species, which exhibits a much better performance than individual conditioning agents. One is highly quaternised amylose [starch hydroxypropyltrimonium chloride] with a strong affinity to hair and small enough to fit into irregularities on the hair surface. The larger Amylose species [hydroxypropyl oxidized starch PG-trimonium chloride] covers the remaining free spaces but is easily removable. Symbio Quat is suitable for conditioning shampoos, which remain clear to 0.4% in anionic systems and at higher levels in non-ionic systems.

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**Naturalis** provides Cuticlex, a conditioning aid based on polyglycerin-3-sebacate with a three-dimensional structure that enables it to adhere to the hair surface giving optimal hydration, boosting shine increasing volume and improving combability. According to Naturalis, Cuticlex protects hair from stress and reinforces hair vigour, improving elasticity and resistance. It is recommended for use in hair colorants at 0.5% to 1%, shampoo at 0.3% to 0.5% and conditioners at 0.3% to 0.5%.

Note: Only the principal ingredients are shown in INCI lists and those interested are strongly advised to seek full information from the suppliers.

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