

Hair Care Feature

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John Woodruff

A developing foetus has all of its hair follicles formed by week twenty-two. At this time there are five million follicles on the body. One million of those are on the head, and 100,000 are on the scalp. This is the largest number of follicles we will ever have; follicles are never added during life. As the size of the body increases with age, the density of the hair follicles on the skin decreases. [Ref 1] So far the cosmetic industry has not developed any products for foetal hair although there are those recommended for pre-natal hair care for the expectant mother.

An estimated 40% of men have noticeable hair loss by the time they reach 35, a figure that rises to 65% by the age of 60. This has prompted much research by the medical profession, pharmaceutical companies and the cosmetic industry, which endeavours to provide products to delay or even reverse hair loss. Hair loss in men usually follows a typical pattern of receding hairline and hair thinning on the crown, and is caused by hormones and genetic predisposition. Contributing causes are scalp glycation and interference with the biochemical pathways that govern hair growth.

Human hair has a three-phase life cycle: the anagen phase is when the hair grows and it may last for two to three years on the scalp. The transitory catagen phase follows, which lasts two to three weeks then hair enters into the telogen or resting phase, which typically lasts for about three months, after which the hair falls out. Alopecia is essentially due to a disruption in hair renewal, which first accelerates the frequency of the cycles at the expense of the hair quality and then of its quantity. This is seen as the formation of weaker, thinner hairs called vellus hairs, which are fine, thin and non-pigmented and the hair bulb is located superficially in the dermis.

There are two types of treatment for counteracting hair loss; dormant hair follicles may be stimulated into producing hair and the anagen and catagen phase may be extended. A review of cosmetic patents in this area reveals several of interest. USP 0020111292 claims that inhibitors of proteasomal activity and of NF- κ B activity stimulate the production of hair follicles and are thus useful in stimulating hair growth and improving hair density. USP 0030073616 claims the use of bradykinin antagonists as the active principle in a cosmetic composition to stimulate hair growth, and control hair loss.

USP 20060210515 describes the use of a partially hydrolyzed fucoidan, a sulphated polysaccharide found in many sea plants and animals that is particularly concentrated in the cell walls of brown algae. The compositions also include an anti-oxidant and a flavonoid and one natural component selected from the group consisting of: witch hazel, mangosteen, honey, aloe, sage, clove, ginger, red pepper, willow, rhubarb, sesame, chamomile, propolis, thyme, lavender, cinnamon oil, flower or blossom oils, olive oil, palm oil, coconut oil, beeswax, and mixtures thereof.

Improving delivery of actives to the relevant area is always of interest to pharmaceutical and cosmetic formulators: USP 0040205910 describes a liposome composition for delivering various actives including those claimed to retard hair loss and improve hair growth. Optimum effects are obtained by the combined use of liposomes that have cationic lipids and it is said that by using liposomes the active ingredients have been transported across the cell membrane and through the cytoplasm and are concentrated at the hair follicles.

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Minoxidil and Finasteride are two pharmaceutical approaches to reducing hair loss:

Minoxidil, also called Rogaine, is a solution applied directly to the scalp to stimulate the hair follicles and Finasteride, also called Propecia, is a prescription pill that inhibits the production of the male hormone dihydrotestosterone. Both approaches are more likely to retard hair loss rather than stimulate new growth and hair loss returns if treatment is discontinued.

The cosmetic approach is to stimulate scalp blood flow and cellular energy; to “nourish” the hair follicles with vitamins and other ingredients; to inhibit scalp glycation and to include natural materials for which there is anecdotal evidence for a beneficial effect. Scalp glycation, causes hardening of the dermis around the hair follicle and this inhibits the development of new hair. An extract of the bark of *Pterocarpus marsupium* was evaluated and found to reduce glycation, inhibit the activity of reactive oxygen species and to reduce inflammation of the scalp. [Ref 2]

Hair follicles have very high rates of metabolic activity and studies of aged follicles often find inadequate capillary circulation in the follicular area suggesting that the resultant lack of nutrient flow may be a contributory factor in the thinning of hair with age. ProCircul 8, **Arch Personal Care**, is claimed to provide a mechanism to not only enhance microcirculation in the scalp, but in the same complex, to deliver protective nutrients to the follicle. The material is a mixture of *Visnaga vera*, a microcirculation stimulant; betaine, which is known to strengthen hair, and a protein-stabilised superoxide dismutase. Also from **Arch** is Vital Hair (&) Scalp Complex; a mixture of saccharum officinarum (sugar cane) extract, citrus medica limonum (lemon) fruit extract, betaine, pyrus malus (apple) fruit extract, camellia sinesis leaf extract and hexapeptide-11 in an aqueous-glycolic solution.

Cosmetochem suggests Herbasc Rooibos, a dry powder extract of *Aspalathus linearis* leaf as a stimulant for hair growth and hair density and it provides supporting evidence from a Dermascan study. Anageline, **Silab**, is claimed to inhibit the activity of 5 α [alpha] –reductase II; the enzyme that catalyzes the hydroxylation of testosterone to 5 α -dihydrotestosterone, thought to be responsible for a decrease in hair growth. It also increases the vascular density around the hair follicle and is said to stimulate cell metabolism and increase keratinisation to improve hair growth.

Sederma supplies Capilectine, an aqueous-glycolic solution of a glycoprotein isolated from *Solanum tuberosum*, and in-vivo results show a 17% increase in the speed of hair growth by activating cell respiration and stimulating keratinocytes. Also from **Sederma**, Procapil is said to target the main causes of alopecia: poor scalp microcirculation, follicle atrophy caused by dihydrotestosterone and follicle ageing. The main constituents are biotinyl-GHK, a citrus flavonoid called apigen and oleanolic acid from olive trees.

Improving microcirculation and cell metabolism are cited as ways of improving hair growth and it would appear that using adenosine triphosphate (ATP) would be a suitable means of achieving this, although this use is not claimed by suppliers of the material. Biophos 35, **Arch**, is a naturally occurring sugar-protein-adenosine complex derived from yeast and designed to re-energise the skin, which is available in liposome form. Unichondrin ATP, **Induchem**, is a mixture of ATP and a protein hydrolysate in butylene glycol recommended for skin moisturising and to improve skin smoothness.

Although hair loss is a biological process, treating the remaining hair with mild cleansing agents and providing good conditioning should reduce hair loss through mechanical stress.

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The trend towards incorporating milder surfactants in shampoo is slow, primarily because of price and consumer expectations of semi-viscous products providing copious foam. Often a compromise is reached by combining sodium laureth sulfate (SLES) with a milder anionic surfactant; thus USP 0060135393 claims a mixture of SLES with sodium lauroyl glutamate or coco glucoside to provide a mild cleansing composition for hair. The example formulation also contains cocamidopropyl betaine (CAPB) and is adjusted to have a surprisingly low pH at 3.5.

Ajinomoto suggest Amalite ACS-12, INCI: Sodium N-cocoyl-L-alaninate, as a mild cleansing agent derived from *l*-alanine and coconut fatty acid suitable for hair shampoo. It is claimed to have good conditioning ability in the presence of cationic polymers and to impart a pleasant moisturising feel after drying but despite its excellent foaming power example formulations still include SLES. Also from **Ajinomoto** are disodium cocoyl glutamate for increased conditioning effect and sodium cocoyl glycinate that can be used to prepare paste-type shampoos with glycerine.

Eucarol AGE, **Cesalpinia**, is a range of alkyl polyglucose esters, manufactured from natural renewable resources and with a remarkably low irritation score; these anionic surfactants have satisfactory foaming properties. They thicken well with CAPB and appear to have excellent wetting and cleaning properties. Although primarily of interest for skin cleansing preparations they can be used to formulate SLES-free compositions, as in the following example.

| Ingredient | %w/w |
|---|-------|
| Sodium cocopolyglucose tartrate (Eucarol AGE-ET) | 15.40 |
| Sodium lauramphoacate | 16.40 |
| Sodium cocoyl glutamate | 5.80 |
| Sorbitol | 2.00 |
| Cocodimonium hydroxypropyl hydrolyzed wheat protein | 2.00 |
| PEG-150 distearate | 1.50 |
| PEG-7 glyceryl cocoate | 1.00 |
| Citric acid to pH 6.3 | 0.70 |
| Preservative / fragrance / colour | qs |
| Water, deionised to 100% w/w | |

Thickening shampoos can present an anomaly; nothing is easier than adding sodium chloride to a traditional SLES/CAPB system but is salt a suitable additive for mild shampoos? Most other surfactant systems present a greater challenge and there are an increasing number of materials being offered. PEG-150 distearate is frequently used but controlling results is not easy. Amidet N. **Kao**, INCI: PEG-4 rapeseedamide, is described as a multifunctional non-ionic surfactant suitable for thickening surfactant systems, including those that are SLES-free, and which also imparts mildness, solubilises perfumes and improves foam. Promidium LT,

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Uniqema, is a mixture of PEG-150 distearate and PPG-2-hydroxyethyl cocamide offered as a liquid thickener for all types of surfactant systems.

Genagen KB, **Clariant**, INCI Coco-betaine, is described as a high performance viscosity builder for SLES systems that can eliminate the need for cocamide-DEA and it may also be used for non-SLES formulations such as those based on acyl glutamates. **Clariant** also supplies a premixed blend of coco-betaine, sodium methyl cocoyl taurate and sodium cocoyl isethionate as Genagen 3SB, although optimised for shampoos and other surfactant products for best performance it requires the addition of SLES.

Univar predicts that formulation trends in hair care will be for products that claim to be botanical or vitamin fortified with exotic additional ingredients for extra hair benefits.

Uniqema believes that in a market that is becoming increasingly mature the focus is on product segmentation with formulations tailored to specific consumer needs, having premium attributes such as vitamins, sun protection and conditioning and there will always be a demand for innovative products.

Hair conditioning from clear shampoo systems is seen as consumer demand and **Uniqema** suggest the use of Arlasilk Phospholipid EFA, INCI: Linoleamidopropyl PG-dimonium chloride phosphate, for this purpose. Traditionally conditioning shampoos contain a cationic polymer that is solubilised by the formation of soluble ionic complexes but these show limited deposition on hair or they may form insoluble associative complexes that are incompatible with anionic systems and show poor conditioning. Arlasilk Phospholipid EFA forms a complex between the cationic polymer and anionic surfactant and this coacervate deposits on the hair to impart a lubricating effect and improve wet and dry combing. It may also be used to deliver other beneficial ingredients including silicones, vitamins and UV absorbers.

The ability to form coacervate systems is also exhibited by SoftCat Polymers, INCI: Polyquaternium-67, from **Amerchol-Dow**. Differing in molecular weight and viscosity these polymers are said to show substantivity to hair and to improve the deposition of other actives. Liposomes are also useful in this regard and **Lipotec** provide a number of these derived from vegetable lipids from safflower oil and containing vitamin E acetate, panthenol and ethylhexyl methoxycinnamate. An alternative approach is proposed by **Soliance** whereby the actives are encapsulated in multi-lamellar micro-vesicles approximately 100 microns in size and trade-named Hairsphere AG. They encapsulate oils, fatty acids and ceramides, and because of their cationic nature, they are substantive to hair but may be incorporated in shampoo without problem.

Beraca ARS Hair system, **Beraca Ingredients**, is described as a unique, natural blend of *Euterpe oleracea*, *oryza sativa* (rice) bran oil and passiflora incarnata seed oil rich in natural flavonoids and gamma oryzanol. It is recommended for use in shampoo to confer shine, silkiness and moisturising to hair. Capilisse, **Silab**, is a quaternised polymer of soy proteins to coat and smooth the hair when incorporated in conditioning products, Amisol Trio, **Lucas Meyer**, is extracted from glycine soja (soy) bean. It contains phospholipids, glycolipids, phytosterols and Vitamin F and is substantive to skin and hair, imparting a pleasant non-tacky, non-greasy and soft feeling. It may be added to shampoos to increase feel and shine and, when added to conditioners, it also improves wet and dry combing and adds volume to the hair.

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Adding volume is one of the current requirements identified for hair products. Consumer studies conducted by **National Starch** showed 90% of consumers in Europe have an interest in adding volume and that they rely mostly on shampoo products to obtain it, with mousse products in second place. In response to these findings National Starch set out to discover ways of maximising volume using the usual hair care forms of shampoo, conditioner, volumising mousse and a styling gel and had much greater success using this regimen than could be achieved using a single product.

The shampoo, conditioner and styling mousse each contained Celquat LS-50 polymer, INCI: Polyquaternium-4/hydroxypropyl starch copolymer. The shampoo and mousse showed significant volumising effects and improvement over leading brands. The volumising styling gel incorporated Celquat H-100 polymer; INCI: Polyquat-4, and gave good results but none of the conditioners examined were particularly effective and it is suggested that they are not the ideal type of product for adding volume.

Also designed to add volume to hair is AC Volumizing Complex, INCI: Aqua (&) oryza sativa (rice) amino acids (&) polyperfluoroethoxymethoxy difluorethyl PEG phosphate (&) lactobacillus/phoenix dactylifera fruit ferment extract from **Active Concepts**. It is claimed that the amino acids penetrate the cuticle, adding moisture and improving the strength of hair; that the fluorinated material binds to the hair, giving it bounce and volume, and the enzyme material converts saturated fatty acids in and on the hair into unsaturated fatty acids, with a lower melting point, and these add shine and smoothness.

Using silicones in conditioning products is almost universal and will be covered in a future article about the use of silicone compounds in cosmetics. Alternatives include a range of materials from **Zenitech LLC**: Zenester Q is a water-soluble polyester and because of its high molecular weight and cationic charge it shows good substantivity and conditioning. Zenigloss, INCI: Castor isostearate succinate, is a naturally derived polymer which adds gloss and shine to hair and provides a smooth feel. A quaternised version is available under the name of Zenigloss Q, INCI: Polyquaternium 57. This new quaternary compound is based on polymerised castor oil. Its cationic nature makes it ideal for hair conditioners and it is very effective on chemically processed hair.

Quest has recently launched Soy-Yogurtene, a pure non-GMO spray dried soy yogurt, INCI: Maltodextrin (&) fermented soyabean extract (&) hydrolysed soy protein. It is recommended for boosting foam in shampoos, to improve wet and dry combing and gives improved dry hair feel and style retention. **Chemyunion** suggests the use of Hydrahair O2, INCI: Butylene glycol (&) tocopherols (&) tocotrienols (&) oryzanol, as an additive for shampoos and conditioners to protect the hair against environmental factors, particularly UV damage and loss of colour due to exposure to sunlight. From the same company, Activeshine Amazon has similar properties and is based on *Orbignya speciosa* kernel oil and *Astrocaryum murumuru* butter. Chemyunion also provide a number of materials based on natural extracts to protect and restore natural hair colour under the Melscreen trade name.

Keeping to the natural ingredient theme **Beraca Ingredients**, have a natural antidandruff material, Beracare ADA, which is a combination of selenium obtained from *Bertholletia excelsa* seed oil and Beta-caryophyllene obtained from *Copaifera officinalis*. Another natural treatment for dandruff is Trikenol from **Provital**; it is described as a synergistic complex of

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two botanical ingredients; manuka concentrate and willow extract enriched with salicylic compounds, developed to offer an effective anti-dandruff active from natural origin.

Finally, not everyone wants more or longer hair; Depiline, Sederma, is designed to slow hair growth and decrease hair density.

Ref 1 <http://dermatology.about.com/cs/hairanatomy/a/hairbiology.htm>

Ref 2 Ref 1. A new way to prevent hair loss: scalp anti-aging by glycation reduction, Christine Jeanmaire PhD, IFSCC Congress in Florence, 2005

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