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New versions and uses for wool

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ABSTRACT

Based on a strong understanding of wool and its components, and strong support for the science behind those components and their application, Keratec Limited has created new versions and uses of wool, as keratin protein products in a range of markets, including personal care, medical devices and consumer health. The scientific approach taken by Keratec Limited, and recent developments in each of the target product areas will be discussed.

INTRODUCTION

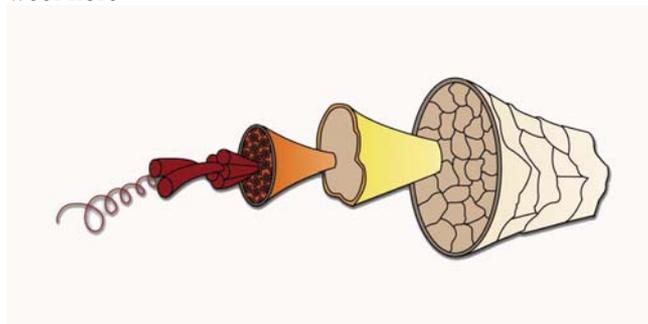
Wool has been a core commodity product for the New Zealand agricultural sector for many years. Wool has been, and will continue to be a key input into the global carpet and textile industry. Traditionally, wool is subject to the pressures of any commodity and in particular pressure from continuous improvement in production efficiency and innovative developments of synthetic fibres create a challenging market for traditional wool products. The premise behind Keratec Limited is to take this traditional product and create an entirely new value proposition for it, taking it into completely non-traditional areas not subject to the same commodity pressures.

For Keratec Limited, wool is a 95% pure source of an optimum blend of keratin proteins. It is a high surface area matrix sustainably produced by one of the world's best agricultural systems. The core features of keratin that ensure a sustainable competitive advantage for Keratec products are the physical and chemical properties it offers as a biopolymer, that can be used in many of the roles currently filled by oil-derived synthetic polymer materials as well as offering properties not achievable with synthetic materials.

Some keratin proteins have been used in cosmetics formulations and other applications previously, in particular shampoos and conditioners. These keratins are typically in the form of low molecular weight protein hydrolysates produced by degradative methods that cleave peptide bonds and irreversibly damage the amino acid residues (particularly cystine) that lead to keratin's unique characteristics.

The proprietary process used by Keratec Limited isolates specific protein fractions from wool in a way that maintains their core characteristics, such as molecular weight and amino acid composition. This leads to the generation of completely novel raw materials for use as many applications. Figure 1 illustrates the regions of the wool fibre from which the different Keratec products originate.

FIGURE 1: Cellular and subcellular components of the wool fibre



The use of a novel process, and the properties of the materials that result from that process, are important factors in establishing new versions and uses for this conventional agricultural product. Furthermore, the value of the new products developed is substantially enhanced through application of a strong science programme to demonstrate the suitability of the novel keratin materials for the proposed applications. By applying science to develop new uses Keratec Limited has taken wool as a commodity and created a range of high value, wool protein-derived products.

The role of intellectual property protection, as a defensive protection mechanism, but also as a marketing tool to create a strong position internationally, is an important part of the Keratec strategy. Keratec Limited has created new versions and uses of wool, as keratin protein products in a range of markets, including personal care, medical devices and consumer health.

PERSONAL CARE MARKET

Keratec IFP was launched as an ingredient for anti ageing hair care cosmetics in April 2004. The following is an excerpt from a recent industry publication profiling the product.

A Consumer's Market

With unremitting product proliferation, consumers can choose from several brands catering to the personal care market. They decided years ago that they did not want to spend their golden years with skin looking like an old leather bag, and science responded

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in kind by driving hundreds of anti-ageing products to market. More recently, the translation of these concepts into other personal care sectors has been broadened. Age associated damage to the hair is now becoming of increased importance. While, according to Datamonitor, the colorants' sector is experiencing growth largely due to increasing availability of home-use products, many consumers want to maintain their own, natural hair color, as well as its soft, youthful texture. "They want hair care where it correlates to changes in hair cuticle and cortex health," reported Keratec Limited. Once again, consumers can choose as suppliers launch anti-ageing hair care products.

Damaging factors

Sunlight, pollution, styling and cleansing are all stresses that prematurely age the hair, leaving it dull, brittle and aged. Anti-ageing has become increasingly important within the hair care market, and as consumers become aware of the negative effects of environmental factors on the body, they look for targeted solutions to combat these aggressions from UV light, chemical treatments, thermal exposure and mechanical manipulation. Therefore, ingredients that reduce the effects of these aggressors are well suited to current markets.

Answers to anti-ageing

To target this consumer need a new purified keratin derived protein, Keratec IFP, has been developed by Keratec Limited. Keratec IFP is a patented keratin-derived active designed to protect the hair from environmental exposure by penetrating the cortex and creating a shield on the surface of the hair.

Keratins have been used in personal care formulations for some time. Their main role have been to moisturise hair, skin and nails and also to provide flexibility and strength. The bulk of these keratins have historically been derived by hydrolysis to produce low molecular weight peptides. Recently, it has been shown that ageing of the hair fibres can be retarded, and in appropriate conditions prevented, through the use of a unique keratin protein active, Keratec IFP, a purified form of the keratin intermediate filament protein.

The keratin product in reference is a purified form of intermediate filament protein with components of intact protein and peptide. The intact intermediate filament protein has film forming properties and, when used in hair care formulations, is deposited on the surface of the hair fibre. The lower molecular weight peptide is capable of penetrating into the cortex of the hair fibre. This dual action surface coating and penetration of the peptide leads to anti-ageing efficacy by degrading the proteins deposited on the hair fibre surface and through anti-oxidant activity from fractions capable of penetrating into the cortex.

The UV effect

It is now well established that ultraviolet (UV) radiation from the sun has a damaging effect on hair, resulting in photooxidation and the cleavage of

structural bonds, as well as crosslinking reactions which lead to dryness, brittleness and poor manageability.

The anti-ageing effects of Keratec IFP are demonstrated through measurement of the tensile properties and the effect of UV irradiation on the chemical characteristics of the fibre.

The degree of damage is manifested more intensely in 'aged' hair - increasing damage is observed upon increasing distance from the scalp. Raw materials that can prevent alterations to this physiochemical make-up retard the ageing process. Of all the amino acids present on the fibre surface, tryptophan is the most sensitive to UV-B radiation. We can evaluate the early stages of hair damage by quantifying tryptophan levels of naturally weathered hair and hair prior to and following sunlight exposure or artificial UV irradiation. There is a regular decrease in emission intensity with distance from the scalp, and therefore age of the fibre. This is indicative of the degradation in the surface tryptophan, and health of the hair surface as the fibre ages.

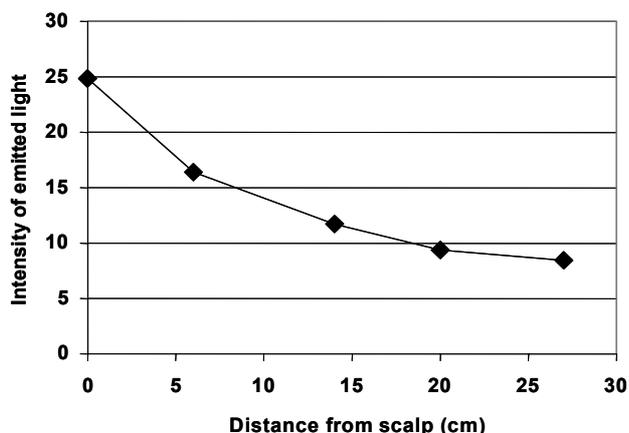
In a test to reproduce the natural ageing of hair, sunlight is mimicked using UV radiation in a fluorescence spectrophotometer. The progressive damage to the fibre surface is evidenced by the consistent decrease in tryptophan emission with each UV irradiation, wash cycle. When the aged hair fibres were compared with hair treated with the Keratec IFP active subjected to same UV conditions, the treatment with the active left the hair surface intact. In this case, damage is done preferentially to the Keratec IFP active, and the hair fibre surface maintains its integrity.

This prevention of ageing is mainly attributed to one of the two components of the active. Surface protection is attributed to the intact keratin intermediate filament protein, the fibrous protein responsible for keratin fibre strength. This intact protein shows a high propensity towards film formation and binds preferentially to the fibre surface. Being intact keratin, this component is damaged by the same environmental processes which damage hair keratin, and by forming a protective layer on the fibre surface this damage occurs preferentially to the active, rather than the fibre beneath. By preventing damage occurring to the fibre cortex, the active acts to maintain the fibre strength. Through this sacrificial protection mechanism, age-associated damage of hair can be prevented and the hair is maintained in a desirable, youthful state. The Keratec treatment is another example of how science is responding to the consumer demands and why consumers today can choose.

(From: Global Cosmetic Industry, Allured Publishing)

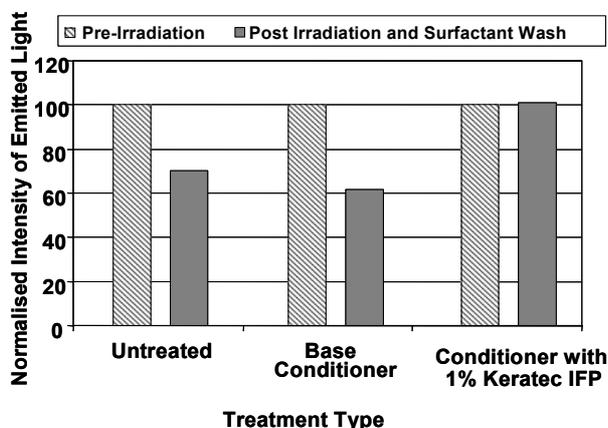
Figure 2 illustrates tryptophan variation occurring naturally down a long hair fibre, indicating that as a fibre ages the tryptophan is degraded and the fibre surface is in poorer condition.

FIGURE 2: Intensity of tryptophan fluorescence of hair as a function of distance from the scalp.



Through a process in which hair is treated with Keratec IFP prior to exposure to damaging UV light, it has been demonstrated that damage can be prevented and the hair surface kept in a good, and youthful, condition. Figure 3 demonstrates the effectiveness of applying Keratec IFP from a conditioner to hair.

FIGURE 3: Normalised tryptophan emission prior to and following UV irradiation and surfactant wash for untreated, base conditioner treated and 1% Keratec IFP conditioner treated hair fibres.



MEDICAL MATERIAL MARKET

Any new, versatile biopolymer that is accepted by the body and degraded within the body is of significant interest to the global biomaterials industry. Keratec's unique keratin protein products offer potential in many biomaterial applications, and initiatives are well advanced in the commercialization of these, illustrated by a recent press release.

'Keratec joins forces with US biomaterial leader'

'Lincoln, New Zealand – February 16, 2005. Keratec Ltd – a Wool Equities Limited (NZX: WEL) subsidiary – and US company Keraplast Technologies Ltd have joined forces to further develop and commercialise their

keratin-based biomedical technologies and intellectual property portfolios. They have signed a collaborative agreement to make their combined patented technologies available to the designers of orthopaedic and wound care products in international medical markets. The collaboration agreement enables both companies to broaden their range of patented biotechnology solutions and gives Keraplast Technologies Ltd access to Keratec's world-class keratin manufacturing facilities at Lincoln, near Christchurch, in New Zealand.

Both companies have designed a range of patent-protected technologies that use natural keratin-based biomaterials. Keratin, a natural component of human skin, hair and nails, is one of nature's most successful materials. Its toughness and solubility properties, which allow it to perform a fundamental structural role in many biological systems, are also desirable characteristics in medical polymers. Keratin's natural biocompatibility, controllable biodegradability and bioactivity combine to provide an exciting platform for new keratin-based orthopaedic and wound care technologies. Keraplast Technologies and Keratec are at the forefront of global initiatives in this new field. Keratec designs and manufactures proprietary forms of keratin-based biomaterials from the wool of selected flocks of New Zealand sheep. Keraplast Technologies, based in San Antonio, Texas, is the owner of an extensive portfolio of keratin-related patents.

Keratec Technologies Chief Executive Tim Herring said the collaborative agreement offers long-term benefits for both companies. "Between us we have developed ground-breaking technologies in the keratin field. It is logical for us to combine these for the benefit of prospective strategic partners who will exploit the properties of these new keratin polymers in a raft of medical applications. Also, because Keratec has its own manufacturing operations, this agreement provides us with access to a ready supply of keratin biomaterials produced according to our patent-protected methods," he says.

Bruce Foulds, Keratec's Chief Executive, said: "This important strategic milestone establishes Keratec as a designer and manufacturer of patent-protected keratin-based materials for the world's medical market. This agreement puts us in an excellent position to provide keratin-based technologies for prospective international business partners in the multi-billion dollar orthopaedic and wound care sectors."

Earlier this month, Keratec announced that it had acquired all rights to previously jointly-owned intellectual property developed in collaboration with the University of Otago, New Zealand, in the field of orthopaedics.

CONSUMER HEALTH MARKET

Consumer health is a high value market well suited to natural materials with strong scientific backing. Keratec is addressing this market through a

joint health product derived keratin protein, and described by in the media.

'NZ wool protein joint health ingredient well received at US trade show'

'Anaheim, California – March 21, 2005. Cynatine™, a joint-health product developed by Wool Equities Limited (New Zealand Stock Exchange: WEL) subsidiary Keratec, has attracted interest from international consumer health producers at the Natural Products Expo West trade show. More than 1500 natural and organic foods, health supplements and personal care manufacturers and distributors exhibited at the show from 18-20 March. It was attended by more than 36,000 industry professionals from 80 countries. Keratec attracted more than 150 expressions of interest in the product at the show, and several producers are interested in testing Cynatine™ as an active ingredient in consumer joint healthcare products that they are developing.

Cynatine™ is a new joint care product designed as an active ingredient in health supplements to maintain healthy joints and fight the cartilage ageing process. It combines four potent joint health and anti-oxidant properties into a single premium ingredient extracted from pure New Zealand wool. It is a natural, non-allergenic alternative to many other consumer health ingredients, including glucosamine and chondroitin, and requires no undesirable stabilizers such as sulphate or HCl. Cynatine™ also provides full-strength biochemical interventions, unlike many alternatives in this market. Cynatine™ addresses joint-health problems stemming from activities such as sports degeneration and the wear and tear of ageing.

Keratec's Vice President of Research and Development, Dr Rob Kelly, said the global marketplace for nutraceutical products was evolving towards a stronger emphasis on products based on a strong scientific foundation. "Keratec's development and processes stem from extremely innovative science and Cynatine™ has the ability to make a strong impact in the global nutraceuticals industry," he said.

Keratec Chief Executive Bruce Foulds said Cynatine™ would establish the company's presence in the consumer health market. Keratec had already made inroads into the personal care market with products such as keratin-based ingredients for hair care and skin care formulations. The recent attention to the potential side effects of COX-2 inhibiting drugs, which target pain relief, has increased the market's interest in and demand for products that improve joint-health, particularly those based on active ingredients from natural sources. 'With Cynatine™, we have a patent-protected active ingredient derived from natural pure New Zealand wool – a new offering which we believe will create considerable interest in the market.'

CONCLUSIONS

There are many new versions and uses of wool that are of interest to various offshore markets. Based on

a strong understanding of wool and its components, and good backing for the science behind those components and their use in a diverse range of fields, new versions and uses of wool have been developed that are removed from the traditional commodity pressures, and have the potential to command a high return. With one of the best primary production industries in the world, New Zealand is in an excellent position to develop a range new versions and uses for many of its current animal-based products.

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