PhytoCycle® Orange

Pseudo-Protein System

Condition & Protect

up-cycled Oranges

improves hydration

enhances overall hair feel

BACKGROUND

The use of proteins in personal care has come under scrutiny in recent years. The main reason being the association of protein sensitization, which is becoming more and more common. Wheat proteins are particularly divisive due to their potential gluten content, and in Europe, cosmetic regulations specify that their maximum molecular weight must not exceed 3.5 kDa. In hair care, the anti-protein movement has gone even further as "protein sensitive hair" can become stiff and brittle. Some celebrity stylists are even avoiding proteins, as over use can "crack the hair follicle" or "cause breakage".

Inspired by advances in both the food and textile industries, Active Concepts has developed a protein-mimicking material from waste orange pulp and small or "ugly" oranges. Based on modified cellulose, the **PhytoCycle® Orange** promotes similar active functions to that of traditional hydrolysed proteins such as hydration, protection and enhanced hair manageability.

SCIENCE

The number of people affected by celiac disease, gluten allergies or wheat sensitivity is rising sharply. Now, 0.5 – 1% of the global population suffers from some form of intolerance. There are theories that modern wheat varieties contain more immunoreactive proteins than in the past[1,2] or that a lack of microbial diversity within our environment and gut microbiome[3] is the cause of this increase in wheat-related disorders. Gluten is a family of storage proteins found in different cereal grains such as barley, rye and wheat. However, wheat is the most commonly used grain for many different processed foods and baked goods. As wheat or gluten intolerance has increased, so has the offering of gluten-free alternatives available on the supermarket shelves. Often, viscosity modifiers such as xanthan gum or guar gum are used in place of gluten, but these can create an unpleasant gumminess or slimy texture. In baking, cellulose is described as being more effective than these other binders to mimic the structure of gluten. It provides elasticity and strength, acting like glue, to give gluten-free baked goods their proper shape and structure.

Code Number: 16925

INCI Name: Water & Citrus Aurantium Dulcis (Orange) Fruit Extract & Lactobacillus Ferment
INCI Status: Conforms
REACH Status: Compliant
CAS Number: 7732-18-5 & 84012-28-2 (or) 8028-48-6 & 1686112-36-6 (or) 68333-16-4
EINECS Number: 231-791-2 & N/A (or) 232-433-8 & N/A (or) N/A

Origin: Botanical
Processing:
GMO Free
No Ethoxylation
No Irradiation
No Sulphonation
Additives:
Natural Antimicrobial: Lactobacillus Ferment
Preservatives: None
Antioxidants: None
Other additives: None
Solvents Used: Water
Appearance: Slightly Hazy to Hazy Liquid, Colorless to Pale Yellow
Soluble/ Miscible: Water Soluble
Ecological Information:
93.50% Biodegradability
Microbial Count:
< 100CFU/g, No Pathogens

Suggested Use Levels: 1.0 – 10.0%
Suggested Applications: Condition, Hydrate, Strengthen, Protect

Benefits of **PhytoCycle® Orange**:

- Hair Humidity Protection
- Increased Hair Hydration
- Improved Hair Manageability

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Cellulose is also used to produce different textiles such as rayon, modal and lycocell. Traditionally, these fabrics are made from wood cellulose or pulp. Lycocell especially is considered more environmentally friendly than other natural fibres, such as cotton, as the cultivation of trees does not require irrigation or pesticides. However, the fast and continued expansion of the dissolving pulp industry, estimated to double global production in the next decade, has captured the attention of the fashion industry. There is a global shift in fabric sourcing as brands work to ensure future supply doesn't harm endangered ancient forests or contribute to deforestation.

Sustainable alternative fabrics are being developed in the textile industry with focus on methods of carbon neutral processing or a circular economy. For example vegan leather can be grown from mushroom mycelium and vegan silks can be derived from citrus fruit waste[4]. Inspired by these global movements in food and fashion, we looked to the global orange supply chain as a source of sustainable cellulose and phytocompounds for the development of a pseudo-protein active for use in personal care.

Sustainability must be integrated into a business at every level. With manufacturing sites in the USA, Italy and Taiwan we are able to supply products locally, recognizing the needs of these regional markets while reducing our carbon foot print. It is no coincidence that we looked to the orange supply chain for our sourcing, as these three countries (USA, Italy and Taiwan), are renowned for producing high quality oranges for both eating and juicing. Working with local suppliers in each country we source orange pulp waste (as a by-product of the juicing industry), or oranges too small for sale, to process and extract our protein-mimicking active.

Proteins are macromolecules, which naturally provide structure. They create elastic networks and flexible films and bind to surfaces such as the skin or hair. Coating the hair with a structure of modified orange cellulose, can help to conjugate the proteins of the hair strand, helping to improve the hairs' innate strength and flexibility. To achieve this, the waste orange fruit material undergoes enzymatic extraction and modification. This results in a water soluble active that can plate out across the hair to smooth and strengthen.

BENEFITS

The **PhytoCycle® Orange** is a pseudo-protein system. This active can be used to replace proteins in hair care applications, promoting comparable benefits of hydration, protection and manageability. Derived from upcycled orange fruit waste, this natural active supports the sustainable and clean movement, allowing brands to build a sense of trust and transparency with their valued customers.

EFFICACY

A gravimetric analysis was performed to assess the hair hydrating ability of **PhytoCycle® Orange** compared to traditional hydrolyzed keratin, a protein commonly used in hair care applications for reducing frizz, and promoting smoothness, elasticity and moisture. Four hair swatches were weighed, and then treated with either 5.0% **PhytoCycle® Orange**, 5.0% AC Keratin Hydrolysate 30 PF, water, or nothing (untreated control). After treatment, the hair swatches were weighed, placed into a constant temperature-drying oven for 1 hour at 105°C and weighed one last time. Hair hydration was determined by calculating the percent moisture per hair swatch. The results of the study suggest **PhytoCycle® Orange** is capable of maintaining hair hydration comparable to animal-derived hydrolyzed keratin.

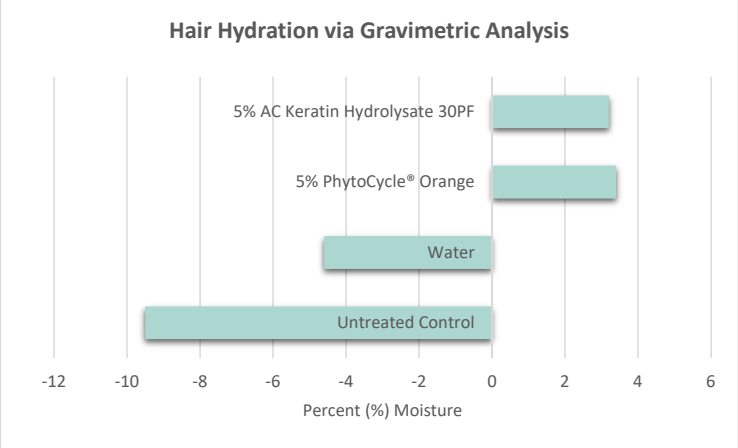

Figure 1. Percent Moisture by Gravimetric Analysis.

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A humidity protection analysis was conducted to assess the hair manageability provided by the **PhytoCycle® Orange**. Four bleached hair swatches were collected and treated with either 5.0% **PhytoCycle® Orange**, 5.0% AC Keratin Hydrolysate 30 PF, water or nothing (untreated control). Each test swatch was evenly soaked in its designated treatment and blown dry for one minute. Initial images were taken post treatment and drying. The hair swatches were then placed in the humidity chamber in a natural hanging position. A 2000 ml beaker of boiling water was placed into the chamber and the lid secured. The temperature and humidity were monitored for the duration of the exposure. Final images were taken after 30 minutes. The results demonstrate that **PhytoCycle® Orange** is capable of protecting the hair from the deleterious effects of high humidity environments comparable to that of hydrolyzed keratin.

Figure 2. Left: Pre-Humidity Exposure. Right: Post 30-minutes Humidity Exposure.

Confocal microscopy provides high resolution images, allowing for the observation of hair in its natural environment and with minimal damage. Both the surface and the internal structures can be observed. Scanning Electron Microscopy Imaging (SEM) provides images of the hair's surface topography and surface composition. These two analysis were applied to compare the effects of **PhytoCycle® Orange** vs Hydrolyzed Keratin Protein on bleached hair (one process at 40v/12%). Virgin hair and bleached hair were used as the positive and negative controls. Bleached hair tresses were treated with solutions of 2.0% **PhytoCycle® Orange** or 2.0% AC Hydrolyzed Keratin 30 PF in water. Images were captured on a Zeiss LSM 700 Laser Scanning Confocal Microscope or a Zeiss Sigma HD variable pressure SEM.

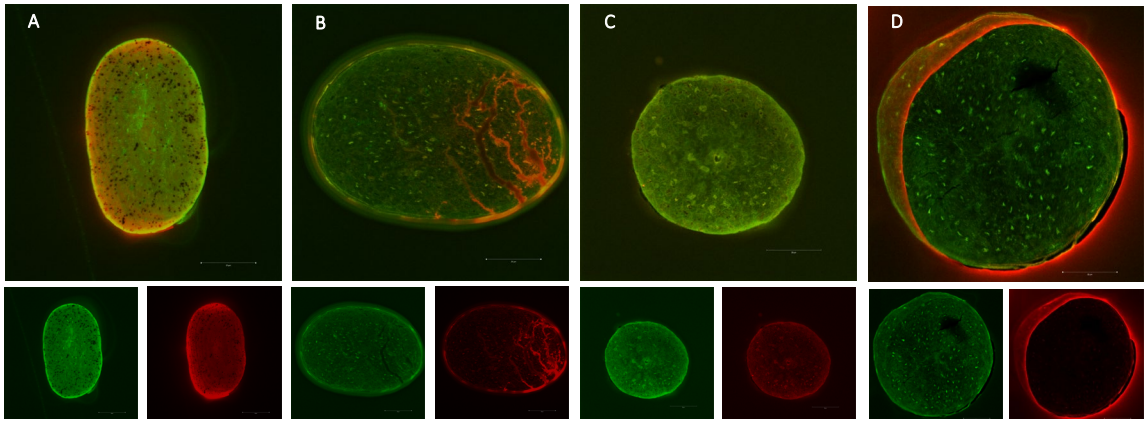

Figure 3. Confocal Microscopy of Virgin Hair (A) Bleached Hair (B), Bleached Hair + 2.0% **PhytoCycle® Orange** (C) Bleached Hair + 2.0% AC Hydrolyzed Keratin 30 PF (D). All images present the result with the GFP filter, rhodamine filter (Rhod) and the combination of both filters (Merge = (GFP+Rhod)). Virgin hair presents high red/green florescence. Damaged, bleached hair with fewer lipids presents darker areas and cracking.

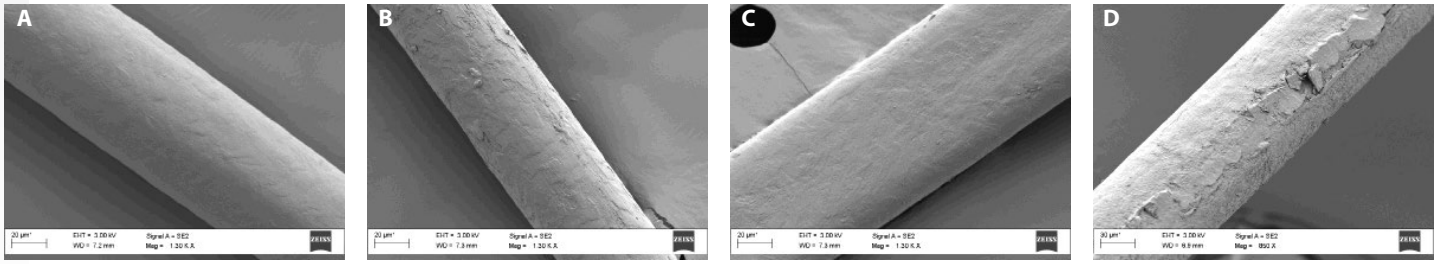

Figure 4. SEM imaging of Virgin Hair (A) Bleached Hair (B), Bleached Hair + 2.0% **PhytoCycle® Orange** (C) Bleached Hair + 2.0% AC Hydrolyzed Keratin 30 PF (D). Bleached hair shows a more prominent and raised cuticle. Treatment with **PhytoCycle® Orange** shows a smoothed cuticle comparable to that of the virgin hair. Treatment with AC Hydrolyzed Keratin 30 PF shows a distinct film on the hair.

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A half head study was conducted to compare the activity of a control shampoo and conditioner supplemented with 2.0% hydrolyzed wheat protein vs. 2.0% **PhytoCycle® Orange**. Each volunteer's hair was photographed prior to the treatment and again after the shampoo and conditioner had been applied and the hair was styled. The images of the half head study were used in conjunction with a sensory assessment subjectively rating the parameters: cleansing, smoothing, dry and wet combability, anti-frizz, overall feel, shine and hydration. This assessment was conducted both before and after treatment. Based on the results obtained, the protein free **PhytoCycle® Orange** performed equally, and in some cases better, than the hydrolyzed wheat protein control. The **PhytoCycle® Orange** proved to be an efficient protein-free alternative for rinse-off formulations without any compromise to hair characteristics.

Figure 5. Full Head Baseline, Untreated Hair.

Figure 6. Half Head Treated.

Comparison of Control Conditioner (2.0% Hydrolyzed Wheat Protein) vs. Experimental Conditioner (2.0% PhytoCycle® Orange)

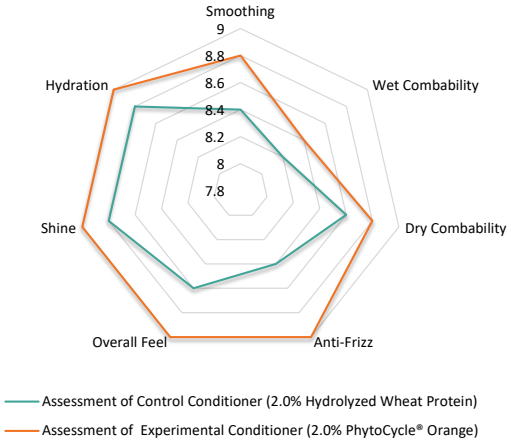

Figure 7. Hair Assessment Results for Sensory Characteristics in a Conditioner.

References:

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3. Pronin D, Börner A, Weber H, Scherf KA (2020) Wheat (Triticum aestivum L.) breeding from 1891 to 2010 contributed to increasing yield and glutenin contents but decreasing protein and gliadin contents. J Agric Food Chem, DOI: 10.1021/acs.jafc.0c02815.
4. Katz, S. E. (2012). The art of fermentation. White River Junction, Vt.: Chelsea Green Pub
5. Patent WO2015018711A1: Production of textile from citrus fruit.

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