The increasing use of products that contain no polyoxyethylene has led to the creation of new classes of basic materials that are of natural origin and free of ethylene oxide, but at the same time versatile and with pleasing cosmetic qualities. One of the classes receiving a lot of attention is the lipoproteins.

An Olive Oil Lipoprotein

Lipoproteins are molecules that have both a hydrophilic (protein) and a lipophilic (fat- or oil-derived) segment. A vegetable-derived lipoprotein surfactant has a lipophilic component consisting of vegetable-derived fatty acids and a hydrophilic section consisting of peptides. The two types of components are joined with an amide bond.

Among the different available sources of fatty acids, olive oil is interesting because of its exceptional fatty acid profile (nearly 85% unsaturated) and its benefits for the skin and human health.

As for peptides, many sources are currently available, extracted from different vegetable species. One of the most efficacious for skin and hair is the one extracted from wheat by hydrolysis of gluten. Gluten is the prevalent protein in wheat grains and serves as the nitrogen reserve for cell multiplication and proliferation, used by the seed at the time of germination. Hydrolyzed wheat proteins perform the same biological function when applied to the skin, aiding the regeneration of skin cells. They are also well known for their affinity with the hair, for their conditioning properties and their ability to ease hair combing. They also dramatically reduce skin irritation due to chemical surfactants.

The lipoprotein called wheat/olive oil polypeptide is obtained by hydrolyzing olive oil and letting the resulting fatty acid mixture react with partially hydrolyzed wheat protein, according to the Schotten-Bauman method. By reacting the end carboxyl group with potassium hydroxide and mixing the resulting compound with lipophilic counter-emulsifying agents (glyceryl oleate, cetearyl alcohol and glyceryl stearate), one can obtain an anionic/nonionic emulsifier suitable for producing oil/water emulsions. Figure 1 shows the structure of a vegetable-derived lipoprotein called Olivoyl Glutinate® (INCI: Olivoyl Hydrolyzed Wheat Protein).

Formulating Considerations

A balanced system: The balanced system of this olive oil lipoprotein material offers forms oil emulsions in water, in the form of lamellar anisotropic phases and places, the resultant product in a state between that of a solid and an isotropic liquid. The micelles are surrounded by multiple layers that keep them organized and separated from each other.

The system also exhibits both amphoteric and anionic characteristics. The amphoteric behavior derives from the amino acids in the peptide chain and is demonstrated when the emulsifier is formulated into products with a neutral pH. The anionic behavior of the system results from the presence of the carboxyl group in the lipoprotein.

With this system one can achieve emulsions that are very fine, stable, and with a bilayer of amphiphile molecules surrounding the micelle. This strengthens the interfaces and reduces coalescence.

Because of its origin, this olive oil lipoprotein system is particularly suited for emulsifying olive oil and its unsaponifiables, and other vegetable lipids, including oils, butters, and even liquid and solid waxes. It is also suitable for blending in hydrophilic and lipophilic vegetable-derived functional substances.

Concentration and pH: The olive oil lipoprotein is compatible with ordinary cosmetic ingredients and can be formulated in the same way as other emulsifiers. It is stable over a large pH range, with an optimum stability between 5 and 7. However, if perfect clarity is required in the final product, a pH above 5.5 is necessary.

The recommended concentration in the finished product is between 2% and 10%.

Preservation: Among the preservatives that can be used with this olive oil lipoprotein system, one could mention the microbial growth inhibitors called self-preservers, such as capryloylglycine, as well as any of the

Key words
surfactant, emulsifier, olive oil, lipoprotein

Abstract
Olive oil and hydrolyzed wheat protein can be combined to form a lipoprotein that functions as an emulsifier and a "green" surfactant.

Figure 1. Structure of olive oil lipoprotein, showing its lipophilic (from olive oil) and hydrophilic (from wheat polypeptides) sections

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following:
glyceric grapefruit extract
biomimetic phospholipids
pentylene glycol
glycerol caprylate

**Phytocosmetic potential:** Olive oil lipoprotein is particularly suited for phytocosmetic applications because it contains no ethylene oxide and is derived from renewable, natural raw materials: olives and wheat. Incorporation of the olive oil lipoprotein into a product merely requires that the water and oil phases be heated separately to 70°C before the water phase is added to the oil phase with stirring. A final emulsification step produces the finished emulsion.

**Rheology:** Thicker emulsions can be obtained without adding rheological additives to the water phase by increasing the percentage of emulsifier from 5% to 10%. However, to thicken very fluid emulsions where the desired emulsifier level is less than 5%, add to the water phase one or more thickening ingredients, such as magnesium-aluminum silicate, bentonite, hydroxyethylcellulose, hydroxypropyl guar, xanthan gum and scleroglucogum.

**Formulations**

Olive oil lipoprotein offers several advantages in cosmetic formulations.

- **Biodegradability.** Release of detergents into the environment damages wild life and eventually the quality of life for humans. Hair-care products represent one of the major sources of this negative impact. Formulating biodegradable shampoos has become an increasingly important issue in recent years. The current availability, and use, of "green" (environmentally friendly) surfactants clearly represents a dramatic improvement in that field.

- **Non-irritancy.** Olive oil lipoprotein offers excellent cutaneous tolerance, enabling it to qualify as a gentle surfactant. But its strong detergent and foaming abilities suggest it could also be used in bath products and shower gels.

- **Biocompatibility.** Olive oil lipoprotein’s biocompatibility and bioactivity suggest its use as a surfactant in hygiene products aimed at cleansing sensitive parts of the body: facial cleansers, makeup-removing lotions and intimate detergents. Formula 1 shows a cleansing lotion containing this ingredient.

**Summary**

Olive oil lipoprotein is a vegetable-derived and biodegradable surfactant, useful for the development of new eco-products. In particular, formulators of rinse-off products, shampoos and detergents can now formulate products that, when rinsed off, will have less negative impact on the environment than traditional, sulfate-containing formulations.

In addition, this “green” surfactant is made from renewable raw materials, using technologies that are friendly to the environment. The components used during the synthesis of olive oil lipoprotein are particularly reactive. The chemical links occur without any excessive heating, and thus involve only moderate energy consumption.

Olive oil lipoprotein appears to be a very convenient ingredient. It is easy to handle as well as friendly to the environment and human body. It can be used alone as a surfactant, or combined with the usual chemical surfactants to reduce the irritation and toxicity of the final formula.

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Table 1. Chemical/physical characteristics of olive oil lipoprotein

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<tr>
<th>Characteristic</th>
<th>Description</th>
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<tbody>
<tr>
<td>Appearance</td>
<td>waxy mass</td>
</tr>
<tr>
<td>Color</td>
<td>ivory</td>
</tr>
<tr>
<td>Odor</td>
<td>slight, characteristic</td>
</tr>
<tr>
<td>pH (water dispersion, 10%)</td>
<td>6.7</td>
</tr>
<tr>
<td>Protein nitrogen</td>
<td>1.2-1.5%</td>
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<tr>
<td>Heavy metals</td>
<td>infinitesimal to 1 ppm</td>
</tr>
<tr>
<td>CNT</td>
<td>infinitesimal to 10 UFG/g</td>
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<tr>
<td>Pathogens</td>
<td>none</td>
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