Jojoba oil

Jojoba is one of the finest cosmetic ingredients in the world. Its excellent inherent emolliency, moisturization and oxidative stability properties rank it as one of the top cosmetic lipid materials, natural or synthetic, in use today. However, simultaneously, jojoba in all likelihood is also the most misunderstood cosmetic ingredient.

Many misconceptions are linked to jojoba, but none is more misleading than the misconception promulgated and propagated by its own common name, "Jojoba Oil." In fact, it is a complex mixture of naturally occurring long-chained linear esters with many functional cosmetic properties that are far superior to triglycerides. Over 97% of jojoba is composed of an array of liquid wax esters, with a combination of mixed tocopherols, free sterols and other unsaponifiable material making up the balance.

In addition to the obvious chemical difference, jojoba differs from triglyceride seed oils in important functional features. Nearly all triglyceride fats and oils are easily hydrolyzed and oxidized for internal food metabolism. Jojoba, like other wax esters in nature, resists hydrolysis and oxidation for more effective, non-occlusive, moisture control and for photoprotection on the external surfaces of skin, hair, eyes and plant leaves.

BOTANY

Renewable Plant-sourced Ingredient

Natural Jojoba Oil is sourced from the seeds of Simmondsia chinensis, which is a woody, evergreen, desert shrub indigenous only to the American Sonoran Desert. Jojoba seeds are a dark, reddish-brown color and about 1.0 to 1.5 centimeters long.

Approximately 50% of the weight of the seed is a mixture of long-chain liquid esters that is typically extracted by mechanical pressing. Unlike most triglyceride seed and nut crude oils, Natural Jojoba Oil is very low in or virtually devoid of tars, gums, free carboxylic acids, hydroperoxides, phosphatides, chlorophylls, color bodies and malodorous low molecular weight carbonyl compounds. Expelled, crude jojoba is naturally of high quality and purity as it flows from the mechanical presses.
CHEMISTRY

Triglyceride Oils vs. Jojoba Esters:

Triglyceride oils are designed to be easily hydrolyzed and oxidized for their intended internal use as foods for energy.

Jojoba liquid wax esters are designed to resist hydrolysis and oxidation for their intended use in non-occlusive moisture control and photo-protection on external surfaces of skin, hair, eyes and plant leaves.

In understanding the functional differences between Natural Jojoba Oil and triglyceride fats and oils, one must understand the molecular differences between long chain liquid esters and triacylglycerols. These differences are very significant even though jojoba, fats, and oils are all considered lipids.

Lipids are important constituents of all plant and animal tissues. The lipid family of compounds includes members of many different structural groups such as fats, oils, waxes, sphingolipids, glycerophospholipids, and sterols. Although they do not share a common structure, lipids do share the property of being soluble in non-polar organic biological molecules such as carbohydrates, proteins, and nucleic acids. Large alkyl portions found in the structures of all lipids are responsible for their solubility properties.

Fats and oils are the most abundant lipids found in nature and are major components of storage fat cells in plants and animals. Fats and oils are very similar in chemical structure. The distinguishing factor is that fats are solid or semisolid at room temperature and oils are liquid at the same temperature (22 to 25° C).

Leaf Tissue: The waxy cuticle forms the major barrier to water loss in most plants. Its surface is coated with epicuticular wax esters that are very similar to those of jojoba.

Skin Tissue: The stratum corneum forms the major barrier to water loss in people. Its surface is coated with sebum that contains 25-30% liquid wax esters very similar to those of jojoba.
Natural Jojoba Oil is NOT A Triglyceride Fat or Oil:

**Structurally or Functionally**

Technically, triglyceride fats and oils are used in plants and animals primarily as a source of energy. Wax esters are used primarily for moisture control, protection and emolliency. Wax esters are generally present only on the surface layers of animal skin and plant leaves. Only the jojoba tree produces commercial quantities of this functional liquid material in its seeds. (Solid carnauba wax is from the leaves of palm trees.)

Natural waxes are complex mixtures of organic compounds that include carboxylic acids, long chain alcohols and to a much lesser extent, alkenes. *Natural Jojoba Oil* is a mixture of long chained, unbranched liquid wax esters that result from the esterification of an omega-9 (double bond located between the ninth and tenth carbon), monounsaturated linear fatty acid and an omega-9, monounsaturated linear fatty alcohol.

The dominant fatty alcohols and fatty acids of jojoba are of C-20 and C-22 in length. Noted that the unbranched, long-chain nature of the alcohol and acid moieties give jojoba esters their non-polar behavior.

*Natural Jojoba* esters are beautifully simple in molecular configuration, symmetry and stability. These esters are surprising in their cosmetic multifunctionality, and are very similar to the esters that make up 25- 30% of human sebum. An even higher level of similar esters from modified sebaceous glands called Meibomian Glands forms a monolayer of lipids that covers the outer surface of the aqueous tear film of the eye. When it is deficient, the tears evaporate four times faster.

Stereochemically, jojoba ’s double bonds are cis in character. It is believed that this cis configuration in jojoba’s linear ester molecules actually adds superior emolliency traits to the *Natural Jojoba* esters.

**Physical and Chemical Properties**

Experience garnered by jojoba growers and processors over the past 15 years has shown that many of
jojoba’s properties do not vary from year to year or from lot to lot. There are, however, some properties that do vary depending on the condition of the seed that is crushed. Armed with the knowledge that to a significant degree, the quality of the end product depends on the condition of the seed to be crushed, producers have developed advanced methods of harvesting, seed handling, processing, and storage that result in optimal seed condition for the highest quality end product.

- **Acid value** is the most frequently determined property of *Natural Jojoba*. Total acid value of jojoba is typically less than 1.0 which can be reduced with refining methods.
- **Peroxide value** is used as a measure of its relative oxidation state at a single point in time. Typically, jojoba’s peroxide value at time of packaging is less than 5.0.
- **Iodine value** is a measure of unsaturation (number of double bonds). *Natural Jojoba* is almost exclusively composed of “diene” making its Iodine Value similar to that of oleic acid. Iodine values are typically in the range between 70 and 90.
- **Saponification value** also is constant and ranges from 85- 100.

**Oxidative Stability**

Jojoba meets the special Stability Challenge of "Naturals" because is extremely stable. It has been shown to be extraordinarily stable in extreme temperatures. Jojoba can be heated to 370°C over a 96-hour period without displaying degradation in general composition and carbon chain length. In addition to thermal stability and of more importance to the cosmetic chemist, jojoba also has unsurpassed oxidative stability.

Many of today’s cosmetic consumers are demanding that cosmetic formulators produce formulations utilizing natural ingredients once again. These "naturals" for the most part are not oxidatively stable.

Thus, the consumer has created an apparent dilemma for the cosmetic formulator by demanding oxidative stability and increased usage of naturals, while simultaneously requiring the 21st century functionality of a high-end "cosmeceutical." In response to market demand, the cosmetic industry is searching for renewable, plant-sourced lipid alternatives to mineral oils, petrolatums and paraffin waxes. *Natural Jojoba Oil* has definitely been identified as a natural material that meets these criteria and satisfies consumer demand.

*Natural Jojoba* liquid esters help also stabilizes oxidatively sensitive natural and synthetic active ingredients. The two most dominant factors inherent in natural lipid materials that affect their oxidative stability are molecular configuration and the presence of antioxidants.

- **Molecular Configuration**: *Natural Jojoba* esters enjoy a relatively simple yet very stable configuration. The long chain linear esters of jojoba are recognized to be significantly less reactive to oxidation than their structure (eg., Lewis structure model) would predict. In part,
Jojoba’s superior stability is attributed to the lack of resonance effect between double bonds along the molecule’s chain. This enhances the resistance of the double bonds to oxidation.

- **Antioxidants:** *Natural Jojoba*, as well as fats and oils from plants, all contain tocopherols that are known to act as free radical scavengers. However, the level of oxidative stability demonstrated by jojoba is higher than would be expected from its 50 ppm tocopherol content. Scientists have, therefore, postulated the presence of a more powerful antioxidant.

**Jojoba exceeds the Stability of Vegetable Oils**

Oxidative stability studies comparing *Natural Jojoba* to commonly used triglyceride fats and oils demonstrate jojoba’s incomparable stability. It improves shelf life and protects from free radicals.

*Natural Jojoba* and several triglyceride oils and oil blends were tested using the OSI method (Oil Stability Index) at 110° C and 130° C. Hydrogenation is a common practice used to increase the stability of many fats and oils, it breaks double bonds of the fatty acid components of triglycerides and adds hydrogen to the carbon atoms resulting in a single covalent bond. Hydrogenation does change the chemical and physical properties of the oils, and in many cases makes them aesthetically less appealing cosmetically due to increased “greasiness” and “heaviness.”

The OSI comparative study clearly showed that *Natural Jojoba* is superior to most oils and fats. Surprisingly, jojoba even compared favorably to synthetically produced “high stability” oil which was designed for use in experimental oxidative stability studies.

Oxidation and rancidity are primary adversaries to the cosmetic formulator. They have been and will continue to be a challenge in formulating. *Natural Jojoba*’s extraordinary oxidative stability helps meet that challenge.

**HISTORY**

**Use in Ancient America**

For centuries the Amerindians of Northern Mexico and the Southwestern United States have held *Natural Jojoba Oil* in high esteem for its valuable qualities. Early Spanish explorers and missionaries recorded that the native Amerindian inhabitants of the American Sonoran Desert used it for sundry cosmetic and medicinal purposes, such as hair dressings, body oils, and skin salves.
In addition, they attributed “mystical” powers to Natural Jojoba Oil claiming that it could alleviate a myriad of bodily ills and cure external ailments such as cuts, scratches, and open sores.

Realizing that most legends have some basis in truth, research chemists in the 1930’s first investigated the composition and properties of *Natural Jojoba Oil*. These chemists realized, to their surprise, that jojoba was not based on triglycerides (glycerol esterified to three long-chain carboxylic acids) as are essentially all naturally occurring liquid oils and solid fats. In fact, the researchers realized that the extract from jojoba seeds was the only plant-sourced material composed of liquid, long-chain esters. They were intrigued with jojoba, but were very limited in their research due to the limitations of the technology of the day. Soon, *Natural Jojoba Oil* fell into relative obscurity that lasted until the late 1960’s and early 1970’s.

**Scientific Rediscovery**

In the late ’60’s and early ’70’s, two events transpired which brought *Natural Jojoba Oil* into the limelight of cosmetic research and development. First, many nations of the world started to become “environmentally conscious” and realized the finite limitations on many of the world’s resources. These nations, either collectively or independently, identified endangered plant and animal species around the world. Soon thereafter, they outlawed the hunting and/or harvesting of these species and prohibited the use of any materials derived from these sources.

Among the endangered species was the sperm whale, whose spermaceti waxes, a mixture of long chain esters, was greatly valued for its functionality in cosmetic applications. Scientists soon found that *Natural Jojoba Oil* could not only replace spermaceti in all applications but discovered that it was actually superior to it.

Secondly, the cosmetic industry commenced a worldwide search for renewable, plant-sourced lipid materials to eventually replace nonrenewable, petrochemical sourced materials, when and if market, supply or cost factors dictated. It was obvious to many that *Natural Jojoba* completely satisfied the needs created by both of the aforementioned events.

**USE IN COSMETICS**

**Different Grades of Jojoba**

Simmondsia chinensis produces a marvelously consistent mixture of liquid esters. Extraction of *Natural Jojoba* from seeds that are in optimal condition results in a very pure and clean initial product that requires minimal processing and/or refining to produce a very high quality, consistent end product.
After mechanical extraction, jojoba is generally screened to remove tiny bits of sediment called "footes" and then filtered. The jojoba is then placed into an insulated processing tank, where it is pasteurized to further ensure product safety and quality. Different grades of jojoba can then be produced:

1) Pure, natural, golden grade
2) Refined and bleached grade

With the pure, natural, golden grade, no further processing is needed after filtration and pasteurization, although for some end-use applications removal of phospholipids is preferable. The jojoba is simply packaged for storage and shipment. This grade of jojoba has a golden-yellow color. Organoleptically, this grade has a very slight, pleasant odor peculiar to jojoba.

From the early 1980s refined and bleached jojoba has also been available. The color bodies are removed with bleaching earths and filtration. Various degrees of decolorization can be attained by this method with Lovibond readings that are typically between those of pure golden jojoba and decolorized/deodorized grade. This grade of jojoba retains a slight odor.

Well established Safety

In formulating cosmetic products, the cosmetic chemist needs problem-free ingredients that have been tested and found to be safe and effective.

The Scientific Literature Review and Technical Analysis prepared for the highly respected Journal of the American College of Toxicology concluded that jojoba is safe as a cosmetic ingredient in the concentrations reviewed (0.1% to 25%). This extensive review documents studies on toxicity, skin irritation, comedogenicity, skin sensitization, mutagenicity, phototoxicity and photoallergenicity.

Natural Jojoba's oxidative stability, thermal stability and lack of support for microbial growth can also increase a products safety and/or decrease its dependence on antioxidants, preservatives and stabilizers.

Extensive use of jojoba as an ingredient in a wide diversity of products by millions of consumers over the past 15 years, as well as widespread use of 100% pure jojoba on skin and hair without adverse effects also verifies its safety.

Skin care

Many of the most effective ingredients for skin care formulations are those with chemical composition and physical properties similar to the skin's own surface layers. Since jojoba is completely miscible with sebum, it forms a very thin, non-greasy lipoid layer of jojoba and sebum when it is applied to the skin. This partially porous layer provides exceptional transepidermal respiration and moisture control. Unlike
greasy occlusive materials such as petrolatum, mineral oils and some lanolin products, jojoba provides an absolutely non-tacky and non-greasy, dry emolliency.

At the same time jojoba significantly reduces Transepidermal Water Loss without totally blocking transpiration of gases and water vapor. The kinking at jojoba’s cis configuration that helps avoid tight packing of hydrocarbon chains enhances this function.

**Natural Jojoba** serves as an excellent moisturizing agent with exceptional spread and lubricity, and leaves a rich velvety non-oily feel on the skin while retarding water loss and enhancing the flexibility and suppleness of the skin.

Percutaneous absorption studies at the University of Michigan demonstrated that jojoba is quickly absorbed into the skin. Absorption is apparently via the transappendegeal mechanism and occurs through the pores and hair follicles. Additionally, because jojoba is rapidly absorbed, the pores and hair follicles can remain open and thus maintain their proper functioning ability.

From the pores and hair follicles, jojoba diffuses into the corneal layer of the skin probably via a pilosebaceous mechanism.

In short, it appears that jojoba effectively moisturizes and softens the skin by a dual action of forming a lipid layer, which is partially occlusive, and by the diffusion of jojoba into the intercellular spaces of the stratum corneum to soften this tissue.

The incorporation of jojoba into the oil phase of skin care formulations is a straight-forward process. **Natural Jojoba** has a required hydrophilic/lipophilic balance number (HLB) of approximately 6. It is considered compatible with almost all anionic, cationic, amphoteric, and non-ionic cosmetic ingredients. Not only can multifunctional jojoba be considered as a replacement for mineral oil, triglycerides, lanolin, squalane and synthetic esters, but it can bring a whole new level of functionality to products.

**Hair care**

Jojoba is an extremely functional ingredient in hair and scalp preparations. Many scalp related problems are caused by a hardened build-up of sebum that clogs the hair follicles and may cause some types of scaling. If this hardened build-up is not removed, it can eventually obstruct the hair follicle's ability to function properly, which can lead to a loss of the hair shaft, and ultimately, death of the follicle. Jojoba rapidly penetrates down to the scalp and hair shaft, and readily loosens and dissolves this hardened build-up. The scalp and hair follicles are left clean and free to continue their normal function.
Jojoba is also an excellent soil-solubilizing agent, which can remove sticky build-up on the hair from many modern hair preparations as well as airborne particulates.

Jojoba will leave the hair clean and supple. Jojoba exhibits a matchless keratoplastic effect that leaves the hair shimmering and brings out the hair’s natural color overtones and brilliance. Jojoba can be used with confidence in most hair preparations at a level ranging from 0.5-3%.

One of the essential functions of lipids on the hair is moisturizing to improve texture and manageability. Keeping the hair fully hydrated is a guarantee of manageability, softness and shine. This is exactly what Natural Jojoba does: it conditions the hair, and prevents it from becoming brittle and dull when exposed to unfavourable conditions.

**COSMETIC APPLICATIONS**

The use of Natural Jojoba has steadily increased in a widely diversified plethora of cosmetic formulations. The more common and current usages for jojoba in cosmetics are the following ones.

**Hair Care:**
- Shampoos, Hair Conditioners, Hair Oils
- Scalp Treatments
- Wave Set Lotions
- Stick Pomades
- Hair Creams,
- Hair Tonics, Hair Sprays

**Skin Care:**
- Facial Moisturizers,
- Facial Cleansers,
- Eye Makeup,
- Remover Eye Treatments
- Body Moisturizers
- Hand Creams
- Shaving Lotions and After-shave Creams and Oils
Scrubs & Masks:
- Foot Care Products
- Massage Oils

Baby Care:
- Lotions, Creams & Oils

Sun Care:
- After-Sun Creams
- Lotions Sun Protection Products
- Self-tanning Products
- Tan Extending Products
- Lip Balm

Cuticle and Nail Care:
- Cuticle Oil
- Cuticle Remover
- Nail Hardener

Makeup Products (Color Products):
- Cream Foundations
- Liquid Foundations
- Lipsticks
- Solid Foundations
- Concealers / Blemish Sticks
- Eyeshadow / Blusher
- Eyeliner

Bath Oils:
- Dispersing
- Floating

Soaps:
- Liquid
- Bar

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