



The Wonders of JOJOBA

This natural material has a wide range of applications in personal care products.

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JOJOBA OIL is 97% liquid wax and is produced from the seed of the jojoba plant (*Simmondsia chinensis*), an evergreen shrub native to southern Arizona, southern California, the Middle East, Argentina and northwestern Mexico. *Simmondsia chinensis* was named jojoba by the O'odham (an indigenous Uto-Aztecan peoples of the Sonoran Desert in the southwestern US), who treated burns with an antioxidant salve made from a paste of the jojoba nut.

Simmondsia chinensis usually grows to a height of 1-2m and may reach heights of three meters or more under ideal growing conditions. *S. chinensis* has a normal life span of at least 100 years and may live more than 200 years. Pollination is via wind or insects. The fruit is a green capsule enclosing as many three seeds. When ripe (3-6 months after fertilization) the capsule splits and reveals the seed, which is brown, wrinkled and about the size of a small olive (there are usually 300 to 1,000 seeds/lbs). The mature seeds are hard, oval, dark reddish-brown with a wrinkled surface and contain 42-58% liquid wax esters.¹ Consumption of large quantities of jojoba seed meal results in toxicity in many mammals, and the indigestible wax is sometimes used as a laxative in humans.²

The native Americans of northern Mexico and the southwestern US have highly regarded jojoba oil for centuries, due to its valuable qualities, and used it for multiple and varied cosmetic and medicinal purposes; e.g., hair dressings, body oils and skin salves. Moreover, these native Americans attributed mystical powers to jojoba oil, claiming that it could alleviate a host of

ailments and cure cuts, scratches and open sores.

Jojoba plantations have been established in a number of desert and semi-desert areas, predominantly in Argentina, India, Israel, Mexico, Egypt, Palestinian Authority, Peru and the US. Excessive cold has been known to kill entire seedling crops. Jojoba, as a desert plant, is very tolerant of high temperatures.³ Jojoba naturally grows in areas that receive 3-18 inches of annual precipitation. Water is most crucial to jojoba growth during late winter and early spring.

Long-term success of commercial jojoba production relies on improved yield and a strong market. The value of jojoba oil as a cosmeceutical ingredient, an alternative industrial fluid with multiple applications and as a replacement for non-renewable fossil petroleum has been demonstrated.

Extraction and Processing

There are several methods for extracting jojoba oil from the seeds. The most direct involve mechanically pressing the seeds with or without the application of heat in a process termed expeller-pressing. The strictly mechanical methods for jojoba oil extraction are cold-pressing and second-pressing. After mechanical extraction, jojoba oil is usually screened and then filtered. Subsequently, the jojoba oil is pasteurized to ensure safety and quality.

1. Expeller-Pressed Jojoba Oil is extracted from jojoba seeds by passing the seed through mechanical presses known as expellers. These machines mechanically press the liquid from jojoba

seeds and sometimes also employ heat in order to facilitate release of the liquid. The remnant from expeller extraction of jojoba oil is the jojoba seed presscake (also called the meal).

2. Cold-Pressed Jojoba Oil is mechanically pressed from jojoba seed without the addition of heat to facilitate pressing. The resulting liquid is usually light gold in color with very little odor.

3. Second-Pressed Jojoba Oil is mechanically pressed from jojoba presscake (the remnant from an initial cold-pressing of jojoba seeds) during a secondary pressing operation. The second-pressed liquid is usually darker than the cold-pressed liquid and often has a distinct, although not unpleasant, odor. Second-pressed jojoba liquid is primarily employed as a lubricant.

A Variety of Uses

Approximately 50% of the jojoba seed weight is the oil. The almost exclusive composition of liquid wax-esters makes jojoba oil unique in the plant kingdom. Jojoba oil's composition of extremely long (C36-C46) straight-chain wax ester makes it and its derivatives more similar to human sebum and whale oil than to traditional vegetable oils. Although initial interest in jojoba oil resulted from the ban on whaling and whale products in 1971, thus

creating an interest in sperm whale oil substitutes, many of jojoba oil's properties make it superior in most applications.

Jojoba oil is easily refined to be odorless, colorless and oxidatively stable, and is often used in cosmetics as a moisturizer and as a carrier oil for specialty fragrances. It also has potential use as both a biodiesel fuel for cars and trucks, as well as a biodegradable lubricant.

Currently, the primary employment of jojoba liquid wax is centered on the cosmetic and personal care industry, mainly due to its emollient property without a sense of greasiness. Incorporation of jojoba oil into skin care formulations is a relatively simple process, as jojoba oil has a hydrophilic/lipophilic balance number (HLB) of approximately 6; i.e., it appears to be compatible with almost all ionic, polar, amphoteric and lipophilic ingredients.⁴

Jojoba meal is a remnant by-product of the extraction of jojoba presscake. Whole jojoba seed contains about 15% protein and 11% anti-nutritional compounds such as simmondsin and its analogs. Jojoba meal is often an ingredient in cosmetic scrub or peeling products, as a mechanical exfoliant, and in creating interesting biologically active extracts.

Simmondsin, and many of its analogs remain in the presscake after jojoba oil is extracted. Several methods are now under development to extract the ferulic acid from the simmondsins for use in antioxidant and UV-enhancing applications.

Chemical Composition

A variety of natural golden liquid wax esters are found in jojoba seeds. Although jojoba oil seems similar to other vegetable oils, its chemical composition closely resembles that of sperm whale oil (which was outlawed in 1971).

Studies focusing on percutaneous absorption of jojoba oil components conducted at the University of Michigan indicated that jojoba oil is rapidly absorbed into the skin, primarily via pores and hair follicles.⁵ Testing has shown that skin elasticity increased by 37% only 30 minutes after application. Other studies have shown that pure jojoba oil noticeably contributes to softening skin well beyond eight hours after application. These data indicate that jojoba oil's skin moisturizing and softening action is enacted both by the formation of a semi-permeable, protective surface lipid layer and permeation into the corneal layer's intercellular spaces.⁶

Jojoba oil also has phenomenal oxidative stability, an extremely important consideration for cosmetic chemists, especially when dealing with natural materials. Many plant oils which have been used in cosmetics for thousands of years; e.g., olive oil, sunflower oil, safflower oil, have the unfortunate

tendency to quickly oxidize; i.e., go rancid, or “spoil.”

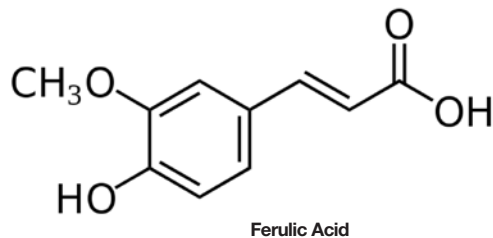
Two properties inherent in jojoba oils which affect their oxidative stability are their molecular configuration and the presence of antioxidants. Jojoba wax is a mixture of long chained, unbranched liquid wax esters formed from unbranched Omega-9 monounsaturated fatty acids and unbranched Omega-9 monounsaturated fatty alcohols. Both of these moieties almost always contain an even number of carbon atoms. Jojoba oil’s double bonds are cis in character, which may enhance jojoba oil’s superior emolliency.

Vitamins E (Tocopherols) are a family of powerful antioxidant lipid-soluble vitamins and excellent free-radical scavengers thus protecting essential fatty acid and vitamin A levels in the body. They significantly help in the reduction of scarring from wounds and the appearance of stretch marks.

Sterols (Phytosterols) are a class of lipid-like compounds that inhibit skin aging by improving skin metabolism and reducing inflammation. They promote excellent moisture retention and rapidly penetrate the skin. They are vital to the structural integrity of the cell membrane.

Ferulic acid (4-hydroxy-3-methoxycinnamic acid) is found in jojoba pressmeal as the acid-derived moiety of simmondsin 2'-ferulate esters. Ferulic acid helps prevent damage caused by

ultraviolet light. Recently, we isolated ferulic acid from jojoba presscake in order to fortify its antioxidant qualities, or employ it independently in other antioxidant and UV-filtering applications.



Health and Cosmetic Benefits

Jojoba oil components are important in healing and/or inhibiting degeneration. The properties of tocopherols as healing agents are well-known, particularly reduction of scarring and stretch marks. Tocopherols also have anti-inflammatory and anti-degenerative properties as does ferulic acid, and tocopherols are also known to facilitate cell nourishment.⁷ Ferulic acid also exhibits anti-allergenic qualities. Jojoba oil’s skin-moisturizing properties correct dryness and improve skin elasticity and, as previously stated, jojoba oil also has many antioxidant benefits. Jojoba liquid wax esters and tocopherols are also proven emollients with the added advantage that they are rapidly absorbed transcutaneously; they are excellent candidates for topical applications. The combined anti-free radical, emollient properties and rapid absorption properties of these substances make them highly effective ingredients in topical photoprotective applications.

Jojoba oil is versatile and its external use is not limited to the skin, but also commonly extends to treatment of damaged, dry or brittle hair. Jojoba oil helps hydrate hair and scalp very effectively by forming a semi-permeable protective layer around the hair thereby sealing in moisture, but still allowing the scalp to “breathe” and actually penetrating into hair shafts and follicular interstitial spaces. The moisture retained in the hair naturally gives hair an attractive and healthy glow, providing instant shine, smoothness and frizz control and also helps strengthen the hair shaft by promoting elasticity, thus preventing any form of hair brittleness from occurring. Jojoba oil also ameliorates many scalp problems relating to hair follicle blockage and potential consequent scaling due to hardened sebum accumulations.

The same emollient and nutritive qualities which make jojoba oil an excellent agent in hair treatments also make it an effective component in regimens for treating brittle nails.⁸

Conclusion

Jojoba oil contains many components which have demonstrated significant health benefits. Some of its more unusual properties are the extraordinarily high concentrations of nearly pure liquid wax esters, which, as mentioned previously, are not found in other plant products and jojoba oil's extreme heat-stability and oxidation-resistance, as compared with other plant oils. Its components have antioxidant; i.e., anti-free radical properties. Jojoba oil has been shown to positively affect wound healing, and it has also exhibited anti-inflammatory, antiseptic, antifungal and anti-aging properties.

Moreover, many cosmeceutical consumers are demanding formulations with natural ingredients. Jojoba oil's superlative moisturizing characteristics and "dry" emolliency further increase its desirability as an ingredient in cosmeceuticals which are based on simple, natural, renewable botanical ingredients, yet are effective and oxidatively stable; i.e., eliminate

Jojoba oil has a wide range of applications in skin care formulations.



the risk of rancidity and consequent consumer health risks due to damage from free radicals.

During the past two decades, the use of jojoba oils has steadily increased in a wide and diversified range of cosmetic applications, including hair care, skin care, baby care products, cuticle and nail care, soaps, color cosmetics and sun care products.

Given the excellent emollient and photoprotective antioxidant qualities of jojoba oil components and the ease of transcutaneous absorption of these components, jojoba oil is an excellent additive as a carrier, photoprotectant, stabilizer and moisturizer in photoprotectant applications in particular, and cosmetics in general. ●

References:

1. W.H. Brooks (1978). "Jojoba—a North American desert shrub: its ecology, possible commercialization, and potential as an introduction into other arid regions". *Journal of Arid Environments* 1: 227–236.
2. D.M. Yermanos (1979). "Jojoba: A crop whose time has come". *California Agriculture* July-August: 4-11.
3. M.N. Nimir and H.M. Ali-Dinar (1991). "Jojoba, a new cash crop in marginal lands". *Acta Horticulturae* 270: 369–372.
4. S. Felix (1980). "Cosmetic applications of jojoba wax". Ben-Gurion University of the Negev, Research and Development Authority, Applied Research Institute, *Scientific Activities* 1978-79 11.
5. K.D. McClatchey, W.J. Ferrell, and C.L. Pierson (1980). "Percutaneous Absorption of Jojoba Oil". *Proceedings from the Fourth International Conference on Jojoba and Its Uses*. Hermosillo, Sonora, Mexico.
6. M.S. Christensen and E.W. Packman (1988). "Skin Surface Softening Effects of Jojoba and Its Derivatives". *Proceedings from the Seventh International Conference on Jojoba and Its Uses*. American Oil Chemists' Society, Champaign, Ill.
7. E. Reiter, Q. Jiang, S. Christen (2007). "Anti-inflammatory properties of alpha- and gamma-tocopherol". *Mol. Aspects Med.* 28(5-6): 668-691.
8. "Jojoba Oil for Nails". *Buzzle.com*.
<http://www.buzzle.com/articles/jojoba-oil-for-nails.html>

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