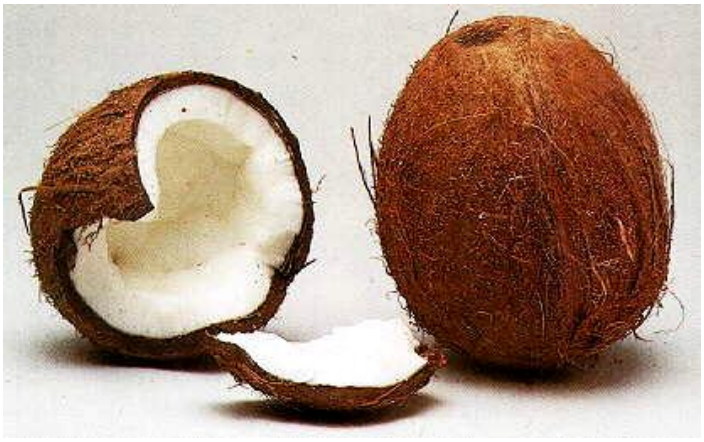
Coconut Milk



BOTANY

Cocos nucifera L. (=Cocos mamillaris Blanco) is commonly known as coconut or coconut palm. It is a palm tree that belongs to the Arecaceae family.

Coconut palm grows up to 10-20m. The trunk is slender, often curved, and is wider at the base than at the top. An apical crown of leaves protects the only growing point of the plant, the terminal bud. The pinnate leaves, or fronds, are 1.5-4m long and bear yellowish-green coriaceous leaflets, which are 50-70cm long. Under favorable environmental conditions, an adult plant produces 12 to 14 new fronds per year. The top, which is not very wide, bears 25-36 fronds. The root system is fasciculated. The primary roots attach the plant to the ground and absorb water. The tertiary roots, which emerge from the secondary roots, are the actual nutrient absorbers.

Since *Cocos nucifera* is a monoeciuous species, its inflorescences bear female and male flowers. The inflorescences are panicles born in the axils of lower leaves, each protected by a large bract (up to 70cm long) called husk. Inflorescences grow during 3-4 months. Flowers bloom between November and March.

The fruit is a large ovoid drupe containing a single seed known as coconut. A coconut is essentially a large hollow seed with a hairy coat, made of the following parts from outside to inside:

- an outer 4-5cm thick fibrous husk called exocarp
- an intermediate, also fibrous though thinner layer called mesocarp
- a hard, bony shell called endocarp, with three pores arranged in a triangle
- a white edible pulp layer called endosperm
- a central cavity containing sweet liquid known as coconut water.

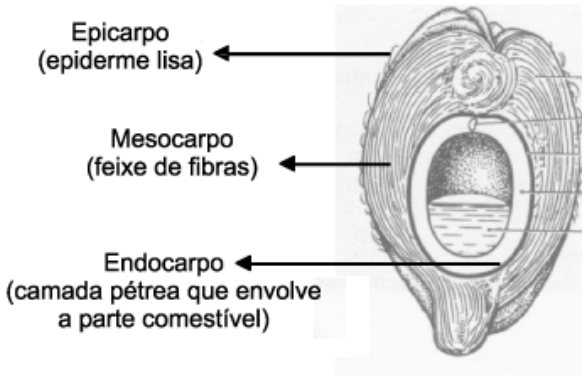


Figure 1. Longitudinal section of a coconut: Epicarpo: Epicarp (smooth epidermis); Mesocarpo: Mesocarp (made of fibers); Endocarpo: Endocarp (hard layer enveloping the edible flesh).

Depending on the variety, the ripe fruits may be green, ochre-yellow or reddish-orange. However, all of them turn to an opaque brown color when dry, before falling from the plant. A single coconut may weight up to 2.5 Kg.

Coconut palms grow on the sandy shorelines of all tropical and most subtropical areas. The borders of its natural distribution are not known. Most experts believe that it is native to the Indo-Malaysian region on the West Pacific coasts. Probably, coconut palm present distribution is directly or indirectly a consequence of human cultivation.

The areas where coconut palms grow, either natural or introduced, are tropical warm and humid areas with average annual temperatures of 27-35°C and mild variations along the day. Annual rainfall in areas with productive plantations is between 1200 and 2300 mm.

ajor World coconut producers include the Malaysian archipelago, Southeast Asian countries, India, Sri Lanka, some Pacific islands, eastern African countries and Central and South American countries.

Coconut milk is an hydrolipidic extract of the *Cocos nucifera* L..

CHEMISTRY

Fresh, not-dried endosperm contains: 10% carbohydrates, 3% proteins and approximately 50% water.

Fatty acids
The coconut endosperm contains 35-40% of oil. This oil is composed by:

- **Saturated fatty acids**
  The main characteristic of coconut oil is the high content of saturated short and medium-sized chain fatty acids:
  - 45-53,2% lauric acid (12:0)
  - 6,8-21% myristic acid (14:0)
  - 7,5-10,2% palmitic acid (16:0)
  - 4,6-10% caprylic acid (8:0)
  - 5-8% capric acid (10:0)
  - 2-4% stearic acid (18:0)

- **Unsaturated fatty acids**
  Coconut content of essential fatty acids is smaller:
  - 5-10% oleic acid (18:1)
  - 1.0-2.5% linoleic acid (18:2)
    (Codex Stan 210; 1999)

Carbohydrates
There are about 10% of carbohydrates in coconut endosperm. Some of them are, D-galactose, D-galacturonic acid, galactomannan, and L-rhamnose.

Proteins
Coconut endosperm contains 3% of proteins, approximately.

Proteins have high affinity with the skin and the hair. This makes these compounds very recommendable to achieve dermatological targets.

Vitamins
mainly, vitamin A, tiamin (or vitamin B_1), riboflavin (or vitamin B_2), niacin and vitamin C.

Other active principles
Organic acids (malic acid, citric acid), fitosterols and minerals (calcium, potassium, sodium, magnesium, phosphorous).

TRADITIONAL USES

The name *Cocos*, seems to come from a Portuguese word meaning "monkey" probably because of the tree marks on each coconut, which resemble an ape's mouth. The species name nucifera is a Latin formation meaning "bearing nuts" (fero = "I bear" and nux-nucis = "nut")
The many medicinal applications of coconut include its use as an antiseptic, astringent, bactericidal, diuretic agent, etc. People in tropical countries usually apply it as a medicine for asthma, bronchitis, bruises, burns, constipation, dysentery, cough, fever, flu, etc. In South Asia coconut oil is: taken as a substitute for codfish liver oil, topically applied to relief fever and respiratory conditions, and used on hair to prevent gray-hair. Dry old endosperm is used as an aphrodisiac ingredient of some preparations and as an antihelmintic medicine to remove tapeworm.

COSMETIC PROPERTIES

Activity on the skin
It is due to its carbohydrates, proteins and fatty acids content.

- **Carbohydrates**
  Coconut has carbohydrates that absorb and retain water under certain conditions. Some carbohydrates are able to remain on the surface of the stratum corneum, thus acting as moisturizing and filmogenic substances, which noticeably improve skin biomechanical properties.

  Moisturizing agents are compounds, which contribute to maintain the skin water-balance. Moisturizers contribute flexibility to the stratum corneum; they facilitate desquamation through their action on corneodesmosomes and affect the lipids, which exert the barrier function.

  Filmogenic agents are macromolecules, which remain on the stratum corneum surface, where they retain water and improve the barrier function.

- **Proteins**
  Challoner, NI et al. (1997) evaluated the moisturizing effect of different proteins, including vegetable proteins and derivatives. In a first assay, they evaluated the moisturizing effects of an O/W emulsion containing 1% protein hydrolyzate. The results showed that the protein hydrolyzate-containing emulsion significantly increased skin immediate extensibility (Ei).

  They also evaluated the lifting effects of two high molecular weight proteins in aqueous solution. The results showed that incorporating proteins into an aqueous formulation significantly decreased Ei during the treatment period. This finding could be explained by the capacity of proteins to form a coating film on the skin surface, which resulted in a lifting effect.

  Thus, low molecular weight proteins are good moisturizers for deep skin layers and high molecular weight proteins – because of their filmogenic action – are good moisturizers for the skin surface, as well as good firming and soothing agents.

- **Fatty acids**
  Xerosis is a common skin condition characterized by dry, rough, scaly, and itchy skin, associated with a defect in skin barrier function, and treated with moisturizers. People in the tropics have used coconut oil as a moisturizer for centuries. Recently, coconut oil has been found to have antiseptic activity on skin. Agero, AL & Verallo-Rowell, VM (2004) carried out a study aimed to determine the effectiveness and safety of virgin coconut oil compared with mineral oil as a therapeutic moisturizer for mild to moderate xerosis.

To that end, a randomized double-blind controlled clinical trial was conducted on mild to moderate xerosis in 34 patients with negative patch-test reactions to the test products. These patients were randomly applied either coconut oil or mineral oil on the legs twice a day for 2 weeks. Quantitative parameters for effectiveness were measured with a Corneometer CM825 for skin hydration and a Sebumeter SM 810 for skin lipids. For safety, transepidermal water loss (TEWL) was measured with a Tewameter TM210, and pH was measured with a pH-Meter PH 900.

The results indicated that coconut oil and mineral oil had comparable effects. Both oils effectively improved skin hydration and increased skin surface lipid levels. Safety was demonstrated through no significant difference in TEWL and skin pH. Subjective grading of xerosis by the investigators and visual analogue scales used by the patients showed a general trend toward better – though not statistically evident – improvement with coconut oil than with mineral oil. Safety of the treatment was demonstrated by the negative patch-test results prior to the study and by the absence of adverse reactions during the study. The authors to this study arrived to the conclusion that coconut oil is as effective and safe as mineral oil when used as a moisturizer.

Therefore, coconut milk is highly recommendable to formulate cosmetic products with skin moisturizing and skin conditioning activity.

Activity on the hair
This action is due to the protein and fatty acids content of the coconut milk.

- **Proteins**
  Proteins protect the hair from environmental damage, repair and condition it, increase elasticity and reduce the risk of breakage (Griesbach U. et al., 1998).

  Low molecular weight proteins can penetrate to the hair-shaft cortex, thus repairing, strengthening and protecting it from the inside. High molecular weight proteins are good hair soothing and protecting agents, because of their ability to coat the hair-shaft surface (Huetter, I., 2003).

- **Fatty acids**
  Keis, K et al. (2005) carried out a study to investigate the penetration abilities of various oils into human hair fibers. An earlier study, where coconut oil was found to penetrate hair while mineral oil was unable to do so, lead to the hypothesis that the reduction in capillary adhesion resulted from the penetration of oil into the hair fiber, leaving a thinner oil film on the surface.
  In the study by Keis, K et al. the authors explored capillary adhesion between hair fibers treated with different types of oils. They found that with coconut, olive, and sunflower oils the capillary adhesion decreased with time, while with mineral oil it did not. They also observed that application of heat further reduced capillary adhesion for coconut and sunflower oils. Oil deposition hair forms thick films (approximately 0.5µm), which mask the scale structure of the fiber surface. As the oil film gets thinner with time and application of heat, the scale structure reappears. Thus, coconut, olive and sunflower oils reduce capillary adhesion because of their penetration ability, leaving a thin film on the hair fiber surface.

Rele, AS & Mohile, RB (2003) carried out a study to evaluate the activity of coconut oil on prevention of hair damage as compared with mineral oil and sunflower oil.

Previously published results had showed that both in vitro and in vivo coconut oil treatments prevented combing damages in various hair types. Using the same methodology, the authors studied the properties of mineral oil and sunflower oil on hair. Mineral oil was studied because it is extensively used in hair oil formulations in India, because it is non-greasy in nature and cheaper than vegetable oils like coconut and sunflower oils. Sunflower oil was studied because it is the second most used base oil in the hair oil industry on account of its non-freezing properties and because it is odorless at room temperature.

Since the aim of the study was to cover different treatments on various hair types using the above mentioned oils, a number of experiments had to be conducted using the so-called Taguchi Technique for the Design of Experiments. The results clearly indicated a strong beneficial impact of coconut oil application to hair as compared to the other tested oils. From these three oils, coconut oil was the only oil found to remarkably reduce protein loss from both undamaged and damaged hair, when used as a pre-wash and a post-wash product. However, sunflower oil and mineral oil did not help to reduce hair protein loss.

The difference in results could be accounted for by the different chemical compositions of these oils. Coconut oil, being a triglyceride of lauric acid, has a high affinity for hair proteins and, because of its low molecular weight and straight linear chain, is able to penetrate into the deepest layers of the hair shaft. Mineral oil, being a hydrocarbon, has no affinity for proteins and therefore is not able to penetrate the hair shaft. In the case of sunflower oil, although it is a triglyceride of linoleic acid, it cannot penetrate the fiber because of its bulky structure due to the presence of double bonds.

Therefore, coconut milk is highly recommendable to formulate hair cosmetic products to protect, repair and conditioning the hair without flattening it.

COSMETIC APPLICATIONS

Action	Active	Cosmetic Application
On the skin	Carbohydrates Proteins Fatty acids	-Moisturizing -Conditioning
On the hair	Proteins Fatty acids	-Hair conditioning -Hair protect -Hair repair

RECOMMENDED DOSE

The recommended dose is between 0.5% and 5.0%.

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