

Virgin Coconut Oil (VCO) – Methods of Extraction and Their Benefits

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Introduction

Coconut belongs to family palmae is an important plantation crop grown throughout the tropic and subtropical regions of the world. The crop is grown in 13 million hectares spread over 90 countries including the Philippines, Indonesia, India, Brazil and Sri Lanka with an estimated production of 69836.36 million nuts. In India coconut is grown in an area of 2.088 million hectare with a production of 22167.45 million nuts. In Karnataka about 5128.84 million nuts per year is produced in an area of 526.38-thousand-hectare coconut oil obtained from the coconut endosperm is one of the most important oils in the tropical region coconut oil has extensive applications not only for edible purpose but also in the industrial processes.

Virgin Coconut Oil

Superior variant of coconut oil called virgin coconut oil is extracted from the fresh and mature kernel of coconut. VCO production does not involve refining, bleaching or deodorizing (RBD) process that a conventional copra coconut oil undergoes. VCO has attained greater relevance owing to its nutritional properties, medicinal benefits and has been a component of a functional food. It is called “virgin” because oil obtained is pure, raw and pristine. It is the purest form of coconut oil, crystal clear, contains natural vitamin-E. It has the capacity to lower the lipid level in serum and tissues and sustain human health. It has received much attention as ‘healthiest oil in the world’ due to its rich amount of medium chain fatty acids especially 48 to 53% of lauric acid that it is considered as a substitute to mother's milk. The global virgin coconut oil market is projected to grow from 2.24 billion USD in 2021 to 3.69 billion USD in 2028 at a CAGR of 7.35% in forecast period, 2021-2028



Health Benefits of Virgin Coconut Oil

- The medium chain (C8-12) fats in coconut oil are similar in structure to the fats in mother's milk that gives babies immunity to disease.
- VCO possesses anti-inflammatory, anti-microbial and antioxidant properties which work together to protect arteries from atherosclerosis and the human heart from cardiovascular disease, boost the immune system.
- Enhances metabolism and reduces obesity protects against hard disease by increasing high-density lipoprotein (HDL) that collects the excess or unused cholesterol in the body for excretion by the liver.
- Provides protection from infectious diseases not easily cured by known antibiotics, improves the nutritional value of food by increasing absorption of vitamins, minerals and amino acids, inhibits the action of cancer-forming substances.

Major Uses of Virgin Coconut Oil

- It is used as hair and skin conditioner.
- As an oil base for various cosmetic and skin care products.
- As a carrier oil for aromatherapy and massage oils.
- As a nutraceutical and functional food.

Comparison between virgin coconut oil and coconut oil

Virgin coconut oil	Coconut oil
Produced from mature fresh meat	Produced from dried copra
Testa is removed before processing	Testa is also used for processing
Temperature during processing ranges from 40 -120°C	Temperature ranges from 150 to 250 °C during refining process
Low free fatty acid content	Comparatively high free fatty acid content
Pure and pristine oil is obtained	Oil obtained is in a crude form with impurities
Refining is not required	Refining is required
No aflatoxins	May contain aflatoxins if drying conditions are unhygienic

Processing of Virgin Coconut Oil

Virgin coconut oil can be extracted directly from the fresh coconut meat or from coconut milk. The different processes involved in VCO production or hot processing method natural fermentation method centrifugation process and extraction from dried grating (EDG) method. The choice of technology to be adopted depends to a great extent on a scale of operation, the degree of mechanization, the amount of investment available and the market demand. 11 to 12 months old fully matured coconut is selected for VCO production. The husk is removed from coconut by using manual or mechanical de-husker. The shell is removed by using chisel type tool or shell removing machine. Testa, the brown outer layer of coconut kernel, is removed by using a manual peeler or coconut testa remover. Testa removed coconut is washed in clean water and cut into 3 to 4 pieces followed by blanching in 50 °C hot water for 5 minutes to arrest enzyme activity. Blanched coconut pieces are pulverized using pulverizer. The pulverized coconut is fed to either manual or mechanical milk extracted to produce coconut milk. Second and third milk extraction is also carried out by mixing warm water (250 ml per kg of residue) to the residue of the first and second milk extraction respectively. Third milk extraction is recommended for fermentation method and it will not be economical for hot processing method. First, second and third extracts or mixed together vigorously for few minutes.



Fully matured coconut
(11-12 months)

husk

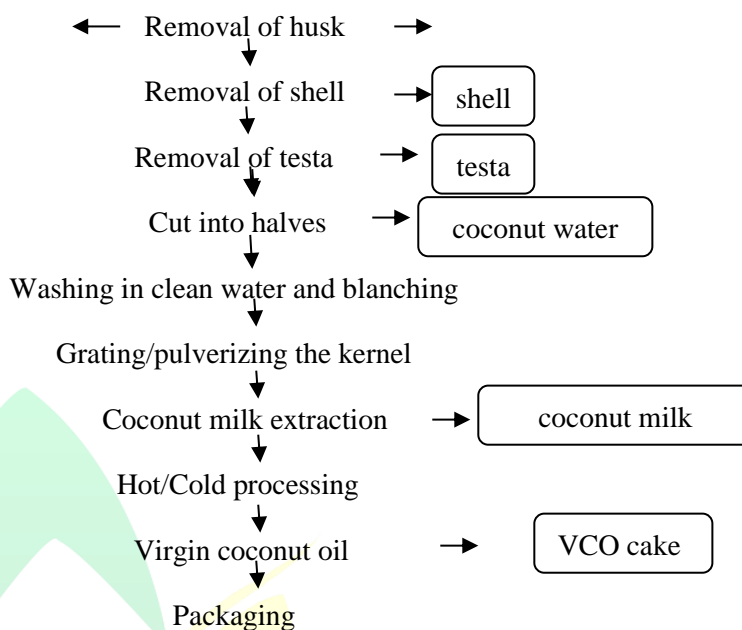


Fig 1: Process of VCO Extraction

Different extraction methods of virgin coconut oil

1. Hot extraction process.
2. Cold extraction process

Fermentation

- natural fermentation
- Induced fermentation

Chilling and thawing

Centrifugation

Aqueous enzymatic extraction method

3. Extraction from dried gratings

Extraction of virgin coconut oil by hot process

In hot process the extracted coconut milk is allowed to stand for maximum 3 hours under refrigerated condition in order to separate coconut cream from coconut skim milk. Coconut cream is separated and placed in a double walled boiler known as VCO cooker developed at ICAR-CPCRI to coagulate the protein and release the oil. After slow heating for about 2 to 2.5 hours, coconut cream will begin to coagulate and separate out the pure oil. In the first hour of heating, temperature can be allowed to reach 120 °C. Thereafter, the temperature is brought down to 90 °C for the protein to coagulate and when the temperature is reduced to

60 °C, oil starts to separate. VCO is separated from the protein rich residue (VCO cake or 'kalkam') by straining the mixture through a muslin cloth or stainless-steel mesh. VCO cake is pressed in hydraulic press to yield more oil. The remaining residue or cake can also be further slow heated to recover more oil. However, this type of oil is yellow in colour and is suitable for skin care or massage products. The oil recovery from hot process is about 20-22% of fresh weight of the coconut kernel. The oil is filtered through sterilized cotton wool filter paper or filter cloth and dried in a double walled boiler at 50 °C for 15 minutes or until the turbid oil becomes crystal clear. VCO can be stored in stainless steel containers and polylined drums. However, for long term storage the recommended packaging material for VCO is glass containers and should be kept away from light.

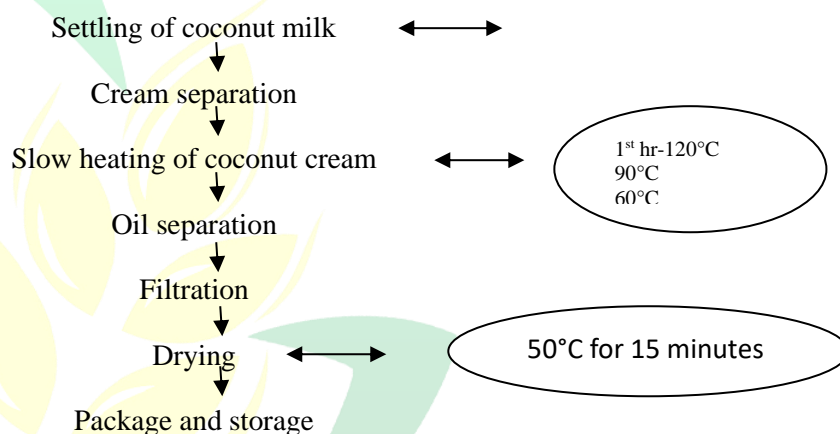


Fig 2: VCO Extraction through Hot Process.

Extraction of VCO by Natural Fermentation Process

In fermentation process, the extracted milk is allowed to stand for 20-24 hours in a food grade plastic or stainless- steel container with a conical bottom with outlet tap and a sight glass to see the different layers as the oil separates during fermentation under favorable conditions of 35 to 40 °C temperature and 75% relative humidity, fermentation process results in fine quality VCO yield which is about 16 to 18% of the coconut kernel weight. To fasten the fermentation process, skim milk @ 30 ml per liter of coconut milk is added to the mixture before the start of fermentation process. If proper operating conditions and sanitary precautions are strictly followed for distinct layers can be seen in the fermentation container after allowing it to settle for 16 hours. The bottom layer is made up of gummy sediment. The next layer is watery and contains fermented skim milk that is no longer fit for human consumption. The next layer is the separated oil for recovery as VCO. The top layer has floating fermented curd. The

fermented curd also contains a considerable amount of trapped oil by carefully removing the distinct layers the oil can be separated. After VCO separation, the fermented curd is heated at 90 °C to recover the residual oil which can be used for making skin care products and soap.

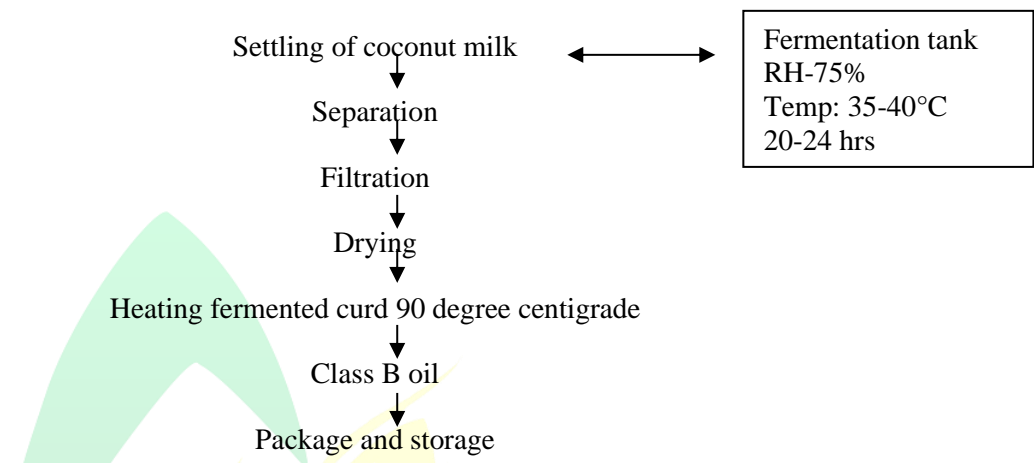
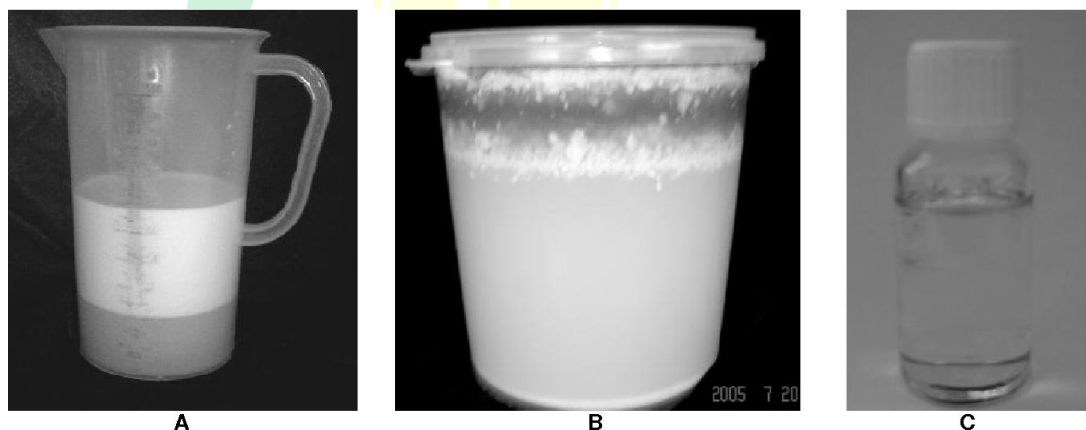
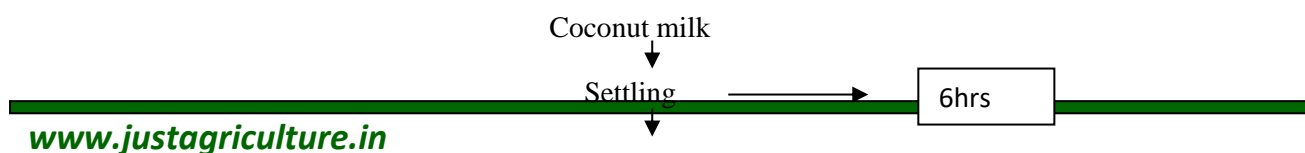


Fig 3: VCO extraction through natural fermentation



Extraction of VCO by induced fermentation process

In induced fermentation method of VCO extraction, the extracted coconut milk is allowed to stand for 6 hours in room temperature for the separation of cream and skimmed milk. The cream then is scooped out and inoculated with 5% (w/w) *Lactobacillus plantarum* and allow to ferment for 10 hours at 40°C temperature. This separated oil is collected and subjected to centrifugation at 4000 rpm for 30 minutes for separation of oil and debris. Oil is collected, dried at 50 °C temperature. Drying gives crystal clear appearance to the oil.



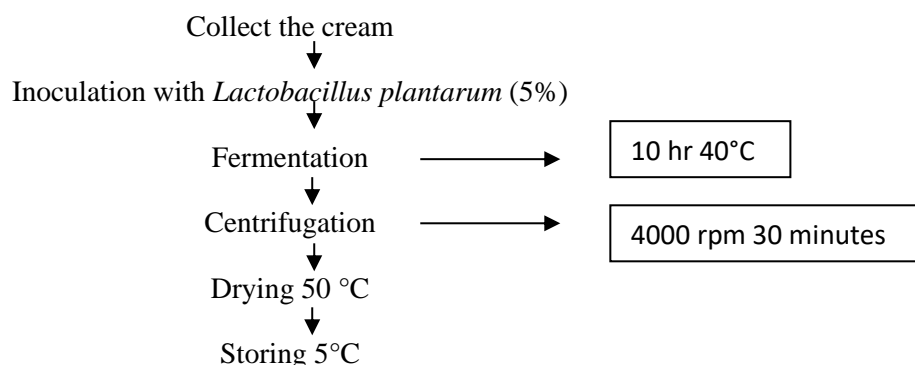


Fig 4: VCO Extraction through Induced Fermentation

Extraction of virgin coconut oil by chilling and thawing method

In this method of extraction, the extracted coconut milk is centrifuged at 4000 rpm for 10 minutes in order to separate the skimmed milk and cream. The cream is scooped out and chilled at 0° C for 6 hours. This facilitates the breaking up of protein bonds thereby releasing the oil particles. The chilled cream is then thawed in room temperature. Here the small globules of oil join together to form one entity. The obtained oil is subject to centrifugation at 4000 rpm for 30 minutes and there by removal of unwanted particles. The oil is then dried at 50 °C and stored.

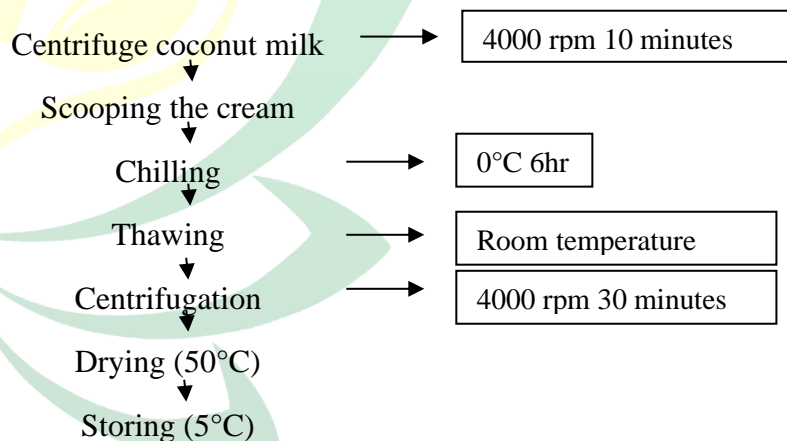


Fig 5: VCO Extraction through Chilling and Thawing Method

One of the simplest methods of extraction of VCO where the extracted coconut milk is subjected to centrifugation at 4000 rpm for 30 minutes twice and then the oil is decanted dried at 50 ° C and stored.

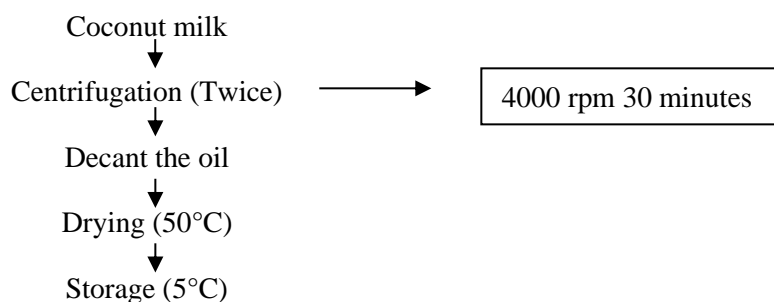


Fig 6: VCO Extraction through Centrifugation

Extraction of VCO by aqueous enzymatic method

Shredded coconut meat is mixed with water in the ratio of 1:4 and the temperature of the mixture is brought to 40 °C using the water bath. Enzymes like amylases (1%) from *Aspergillus oryzae* , pectinase (1%) from *Aspergillus niger*, and proteases (1%) from *Streptomyces griseus* are added to the coconut mixture and temperature is maintained at 40 °C and agitated for 3 hours using a shaking water bath. The various enzymes added will facilitate breaking up of protein bonds and there by releasing oils. After 3 hours the solution is centrifuged at 4000 rpm for 30 minutes at room temperature in order to separate the oil and protein layers and the oil is decanted, dried at 50° C and stored.

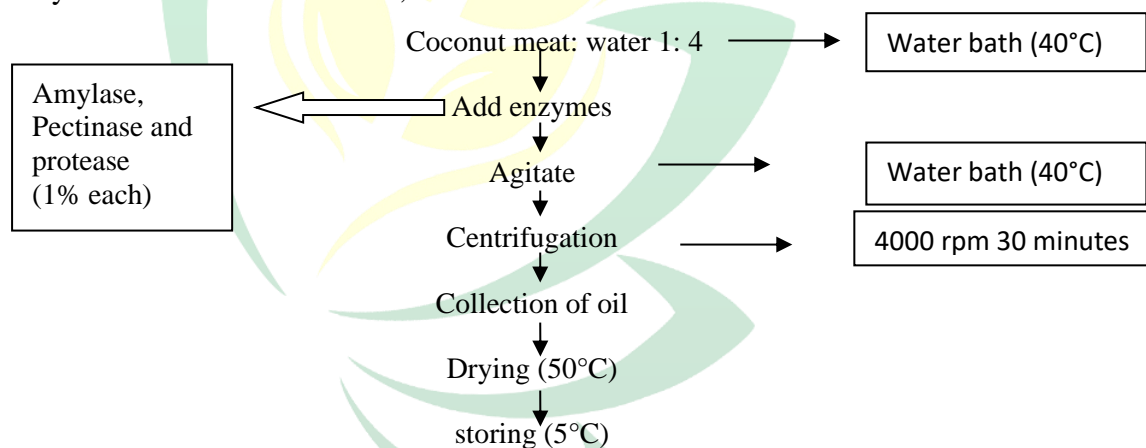


Fig 7: VCO Extraction by Aqueous Enzymatic Method

Extraction of VCO from dried gratings of coconut.

It is another method of extraction of VCO where the coconut meat is shredded and dried at 35 ° C for 48 hours. These dried gratings were subjected to screw press either manual or pneumatic. The crushing action and the pressure employed by the screw press facilitate the breakage of protein bonds in the coconut milk and thus the oil is obtained. The oil is collected, filtered using muslin cloth to remove the unwanted debris, dried at 50°C and stored. But the

disadvantage of this method is that the time taken for drying of the shredded coconut meat provides enough time for the hydrolytic rancidity to occur there by increasing the free fatty acid content. It may also lead to oxidative rancidity.

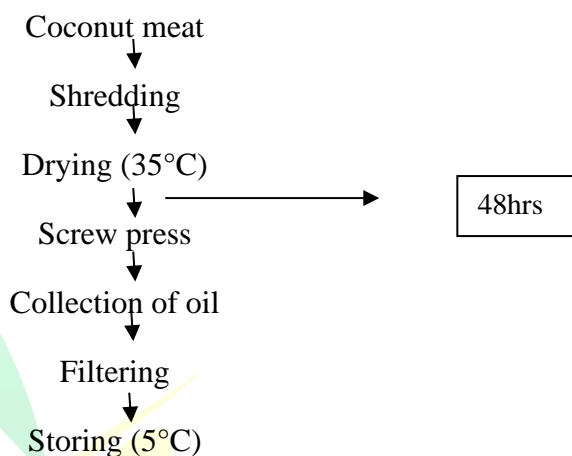


Fig 8: VCO extraction from fried gratings

APCC standards for virgin coconut oil

Essential composition and quality factors of Virgin Coconut Oil.

Parameter	Quantity
Moisture (%)	Max 0.1
Matters volatile at 120 ° C (%)	Max 0.2
Free fatty Acid (%)	Max 0.5
Peroxide value meq/kg	Max 3
Relative density	0.915-0.920
Insoluble impurities percent by mass	Max 0.05
Saponification value	250-260
Iodine value (g I ₂ /100g fat)	4.1-11
Unsaponifiable matter %by mass, max	0.2-0.5
Specific gravity at 30 deg./30 deg. C	0.915-0.920
Polenske value, min	13
Total plate count	<0.5
Colour	Water clean

Odor and taste	Natural fresh coconut scent, free of sediment, free from rancid odor and taste.
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Conclusion

Virgin coconut oil has many users in our daily life as well as industrial applications. Each extraction method has its benefits and disadvantages. Thus, the industry needs to determine which method to be uses in order to meet the needs of the population. Coconut oil extracted from different methods can have different quality and usage. If the coconut oil were to be applied externally, the quality of the oil was not prioritized but the amount of oil being extracted was prioritized. Therefore, a method that provide high oil yield maybe preferred. There will never be a 'perfect' method to satisfy everyone in one method alone, thus multiple methods having invented and tested.

However further study need to development of more effective process for reduce the cost and increase the yield of VCO. Further investigation also needed to improve the downstream process operation which allows the separation of oil from aqueous layer. Compared to other edible oils, virgin coconut oil is not processed or chemically treated and therefore retains all of its healthy plant based nutrients. Cold -processed virgin coconut oil retain more of its health benefits, anti-oxidants and vitamins. Freezing and then thawing the coconut pieces before feeding to the food processor will soften the coconut and allow more milk extraction. The higher amount of polyphenol, phytosterol and monoglyceride content gives a significant medicinal value in terms of diabetes and hyperlipidemia. The biochemical properties of VCO obtained by different extraction methods had no much significant differences. However, higher oil recovery higher antioxidant capacity and health benefits of HEVCO have made it more suitable as functional food oil. CEVCO can be used in skin care products because of the presence of higher tocopherol content which has anti-aging and anti-oxidant properties.