

A Study on Production Process and Challenges in The Coconut Oil Industry

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Abstract— The coconut oil industry is an agro-based sector used in food, cosmetics, pharmaceuticals, and health applications. Production follows a multi-stage process from selection of mature coconuts to preparation, extraction, filtration, moisture control, storage, and packaging. Virgin coconut oil is produced using methods like wet extraction, centrifugation, fermentation, and enzymatic processing to retain nutrients and improve quality.

This study examines the production process and operational challenges in the industry. Strict control of raw materials, moisture, and extraction methods is essential for good oil quality, as each stage affects purity, aroma, stability, and shelf life.

The industry faces challenges such as seasonal supply, price fluctuations, transport issues, labour shortages, machinery breakdowns, energy costs, and competition. Based on secondary data, the study suggests that improving technology, supply chains, and quality control can enhance efficiency and sustainability.

Index Terms— Coconut oil industry, Virgin coconut oil, Production process, Quality control, Industrial challenges.

I. INTRODUCTION

Coconut oil is one of the most widely used vegetable oils across the world. It is extracted from coconut kernels and is extensively used in cooking, pharmaceuticals, cosmetics, traditional medicine, personal care products, and industrial applications. The increasing consumer demand for natural oils, health products, and organic food products has strengthened the importance of coconut oil production. The production of coconut oil requires several carefully controlled stages. The process starts with procurement of mature coconuts and proceeds through preparation, drying, extraction, filtration, purification, storage, and packaging. Modern oil processing also includes scientific methods used in virgin coconut oil production such as wet extraction, dry extraction,

centrifugation, fermentation, enzymatic treatment, and advanced separation technologies.

Besides production activities, coconut oil industries must handle pricing challenges and customer retention issues. Fluctuation in coconut prices, competition from established brands, transportation costs, energy expenses, market price changes, and customer expectations create major business difficulties. Therefore, studying the production process and industrial challenges becomes important for understanding operational efficiency and market sustainability in the coconut oil industry.

Objectives

1. To study the production process of coconut oil
2. To analyze the challenges to Coconut Oil Industries.

II. NEED FOR THE STUDY

The coconut oil industry is an important agro-based sector supporting food, cosmetics, and pharmaceutical industries. With rising demand for natural oils, coconut and virgin coconut oil production has gained importance globally.

Production quality depends on factors like coconut selection, moisture control, extraction, filtration, and storage. Small variations in these stages affect yield, purity, and shelf life.

The industry also faces challenges such as seasonal supply, price fluctuations, labour shortage, transport issues, machinery breakdowns, and competition, affecting production and profitability. This study is needed to understand the production process and challenges in the coconut oil industry and their impact on efficiency and sustainability.

III. REVIEW OF LITERATURE

Ng et al. (2021) conducted a comprehensive review on various techniques used for coconut oil extraction and its applications. The study discusses traditional and modern extraction methods such as mechanical pressing, fermentation, solvent extraction, and advanced separation technologies. It highlights that the choice of extraction method significantly affects oil yield, quality, and physicochemical properties. The study also emphasizes that technological improvements in extraction processes can improve efficiency and product quality in coconut oil production.

Prasanna et al. (2024) reviewed virgin coconut oil production focusing on wet processing methods like centrifugation, fermentation, chilling, and enzymatic extraction. The study highlights that these methods help preserve nutrients, aroma, and overall oil quality, and emphasizes that proper control of moisture and separation efficiency is important for better product quality.

Ng et al. (2021) provided a comprehensive review of coconut oil extraction techniques, including mechanical pressing, fermentation, solvent extraction, and modern methods. The study explains that different extraction methods significantly influence oil yield, quality, and physicochemical properties, and highlights the importance of selecting suitable techniques to improve efficiency and product performance in coconut oil production.

Divate et al. (2026) highlight that coconut processing is an important agro-industry but faces issues like waste, outdated technology, and poor resource use. The study suggests adopting sustainable and circular economy practices to improve efficiency and reduce environmental impact.

IV. RESEARCH METHODOLOGY

The study is descriptive in nature and focuses on understanding the production process and identifying operational challenges in the coconut oil manufacturing industry.

a) Sources of Data

Secondary Data

The study is based entirely on secondary data. The data were collected from research journals, published research papers, conference papers, industry reports,

and reliable websites related to coconut oil production and processing.

These sources were used to study the production process of coconut oil and virgin coconut oil, they were also used to identify operational challenges faced by coconut oil industries.

Analytical Framework

The study analyzes production processes and industrial challenges related to production, pricing, and customer retention.

1. Production Process of Coconut Oil

The production of coconut oil involves two major industrial pathways, namely Virgin Coconut Oil (VCO) production and Commercial Coconut Oil production using the dry or expeller method. Both processes differ in their approach, level of refinement, and end-product quality. However, they follow a systematic flow of operations where each stage plays a critical role in determining the purity, yield, and overall quality of the oil.

4.1. Pathway 1: Virgin Coconut Oil (Vco) Production Process

• Raw Material Selection and Preparation

The production of Virgin Coconut Oil begins with the careful selection of fully matured coconuts, generally aged between 10 to 12 months, as they contain the highest oil content and lower moisture levels. After selection, the coconuts undergo de-husking to remove the fibrous outer layer, followed by deshelling, where the hard inner shell is carefully cracked to avoid damage to the kernel. The brown inner skin, known as the testa, is then removed through a process called paring to improve oil clarity and reduce impurities. The coconut kernel is thoroughly washed to eliminate dust and microbial contamination. Finally, the cleaned white coconut meat is grated into fine particles to increase surface area, which helps improve oil extraction efficiency in the next stage.

• Wet Extraction of Coconut Milk

In this stage, the freshly grated coconut is processed to extract coconut milk using mechanical methods such as a screw press. The pressure applied during this process releases coconut milk, which is a natural emulsion containing oil, water, and proteins. This coconut milk serves as the primary raw liquid from which virgin coconut oil is later separated. The quality

of the extracted milk plays a major role in determining the final purity and yield of the oil.

- **Demulsification (Separation of Oil from Coconut Milk)**

Coconut milk is a stable emulsion, and it must be broken to extract pure oil. This separation process, known as demulsification, can be achieved through several methods such as centrifugation, fermentation, chilling and thawing, enzymatic treatment, or advanced techniques like ultrasonic processing. Among these, centrifugation is widely used in industrial production because it separates oil quickly and efficiently by spinning the coconut milk at very high speeds, typically around 12,000 rpm. Fermentation is a more natural but slower process, while enzymatic and thermal methods help in breaking protein bonds that hold the emulsion together. The choice of method affects both the speed of production and the quality of oil obtained.

- **Layer Separation and Oil Collection**

After the demulsification process, the mixture naturally separates into three distinct layers due to density differences. The top layer consists of pure virgin coconut oil, the middle layer contains coconut cream, and the bottom layer consists of water and other residues. The top oil layer is carefully collected or skimmed to ensure maximum purity. Any mixing with the lower layers can reduce the quality, aroma, and shelf life of the oil, making careful separation extremely important in this stage.

4.2. Pathway 2: Commercial Coconut Oil (Dry / Expeller Method)

Drying of Coconut Kernel (Copra Formation)

In the commercial production method, fresh coconut kernels are first dried to reduce moisture content and convert them into copra. This drying process is carried out at controlled temperatures ranging between 40°C and 50°C to ensure that microbial growth is prevented while preserving oil content. The moisture level is reduced to approximately 2–5 percent, which improves oil extraction efficiency during pressing. Proper drying is essential because excessive moisture can lead to spoilage and reduced oil yield.

Mechanical Expeller Extraction

Once drying is complete, the copra is fed into a mechanical oil expeller, where high pressure is applied to crush and extract crude coconut oil. This process is widely used in large-scale production due to its high efficiency and capacity. Along with oil extraction, a solid by-product known as oil cake is produced, which is rich in fiber and protein and is commonly used as animal feed. Although this method yields a higher quantity of oil, the heat generated during extraction may slightly affect the nutritional quality compared to virgin coconut oil.

- **Finishing Stages (Common for Both Pathways)**
- **Filtration and Purification**

After extraction, the crude coconut oil undergoes filtration to remove fine particles, impurities, and suspended matter. Advanced filtration methods may include the use of activated charcoal or similar adsorbents to reduce free fatty acids and improve clarity. This process enhances the oil's stability, appearance, and shelf life, making it suitable for commercial use.

- **Moisture Control and Stabilization**

Moisture control is an important quality parameter in coconut oil processing. The oil is carefully treated to reduce moisture content to 0.3 percent or lower. This helps prevent oxidation, microbial growth, and rancidity. Proper moisture stabilization ensures that the oil remains fresh and stable during long-term storage.

- **Storage**

The purified coconut oil is stored in airtight and hygienic stainless-steel containers under controlled environmental conditions. Proper storage is essential to prevent exposure to air, moisture, and light, all of which can degrade oil quality over time. Poor storage conditions may lead to rancidity, loss of aroma, and reduced market value.

- **Quality Testing**

Before packaging, the coconut oil is subjected to strict quality testing to ensure it meets required standards. The oil is tested for parameters such as clarity, aroma, acidity level, moisture content, and overall purity. Only batches that meet quality standards are approved for final packaging and distribution.

- **Packaging**

The final stage of production is packaging, where coconut oil is sealed in tamper-proof, hygienic containers. Proper packaging protects the oil from contamination, oxidation, and leakage during transportation and storage. It also enhances product shelf life and ensures better presentation in the market.

The analysis of coconut oil production clearly shows that it is a highly structured and multi-stage industrial process where each step directly influences the final quality of the product. Virgin Coconut Oil production focuses on purity and minimal processing, while the commercial expeller method focuses on higher yield and large-scale production. Across both methods, factors such as moisture control, proper extraction, filtration efficiency, and storage conditions play a crucial role in determining the final quality. Therefore, maintaining strict process control at every stage is essential for producing high-quality coconut oil suitable for commercial and consumer use.

2. Challenges Faced by Coconut Oil Producing Companies

- **Raw Material Supply and Seasonality Issues**

Coconut oil production depends heavily on the continuous availability of mature coconuts. Since coconuts are agricultural products, their supply is seasonal and affected by weather conditions such as rainfall, drought, storms, and cyclones. During peak seasons, raw materials are easily available, but during off-seasons, supply reduces significantly, leading to production slowdowns or temporary stoppages. This also increases raw coconut prices, which directly raises production costs and reduces profit margins.

- **Pest and Disease Infestation**

Coconut plantations are severely affected by pests such as rhinoceros beetle, red palm weevil, and coconut mites. These infestations reduce fruit quality and productivity, sometimes causing significant yield losses. As a result, industries face shortages of good-quality coconuts for processing.

- **Transportation and Logistics Constraints**

Many coconut oil producers rely on coconuts sourced from different regions. Poor rural infrastructure, long-distance transport, and monsoon-related road disruptions often delay raw material delivery. During

transport, coconuts may also absorb moisture or get damaged, affecting oil yield and quality. Rising fuel costs, toll charges, and vehicle maintenance further increase logistics expenses, making overall production more expensive.

- **Labour Availability and Workforce Management Issues**

Coconut oil production is labour-intensive, requiring workers for breaking, drying, cutting, and processing. However, companies often face a shortage of skilled local labour. This leads to dependence on external workers, increasing costs due to accommodation, transport, and welfare needs. Communication and coordination issues between workers from different regions also reduce operational efficiency.

- **Machinery Breakdown and Maintenance Problems**

Oil extraction depends on machines such as dryers, copra cutters, expellers, filtration units, and packaging systems. Continuous usage leads to wear and tear, frequent breakdowns, and production delays. In remote locations, access to skilled technicians and spare parts is limited, increasing downtime and maintenance costs. This directly affects production continuity and efficiency.

- **Financial Constraints and Limited Investment**

Many coconut farmers and processors lack access to finance and credit facilities. High cost of modern machinery and limited government support restricts investment in advanced processing technologies and modernization of the industry.

- **Weak Marketing and Branding Systems**

Coconut products often lack strong branding and market identity, which reduces competitiveness in global markets. Inefficient marketing strategies, poor packaging, and dependence on intermediaries further reduce profit margins for producers.

- **Weather-Related Production Disruptions**

Weather conditions play a major role in coconut quality and supply. Excess rainfall increases moisture content in coconuts, leading to fungal growth and spoilage. High temperatures can cause uneven drying, while storms and floods disrupt transportation and

harvesting. These uncertainties make year-round production difficult to maintain.

• Raw Material Price Fluctuation

The cost of coconuts varies widely depending on season, availability, and market demand. During shortages, prices rise sharply, increasing production costs. Since coconut is the primary raw material, even small price changes have a major impact on profitability and final product pricing.

V. DISCUSSION

The findings of this study show that a well-structured production process and proper quality control play a crucial role in determining the quality and efficiency of coconut oil and virgin coconut oil production. Each stage of the manufacturing process starting from raw coconut selection, de-husking, deshelling, grating, extraction, demulsification, filtration, moisture control, storage, and packaging—directly influences the oil yield, purity, aroma, and shelf life of the final product. The analysis indicates that when proper production practices are followed, coconut oil industries are able to achieve higher oil quality, improved stability, better moisture control, and enhanced extraction efficiency. Advanced techniques such as centrifugation and enzymatic extraction in virgin coconut oil production help improve purity and maintain natural nutrients, while mechanical expeller methods support higher production output.

However, most production issues arise due to variations in raw material quality, seasonal availability of coconuts, improper moisture control, machine breakdowns, labour shortages, and inconsistent processing conditions. These factors reduce overall efficiency and affect product quality and profitability. It is also observed that strict quality control measures and standardized production practices can significantly improve consistency and reduce defects. Proper storage conditions, filtration techniques, and moisture management play an important role in preventing rancidity and extending shelf life.

Overall, coconut oil production is a highly interdependent process, and its success depends on accurate processing methods, efficient resource management, and strong operational control. Improving production technology, supply chain

management, and quality assurance systems can significantly enhance industrial performance.

VI. FINDINGS

- The coconut oil production process follows a systematic sequence including raw material selection, preparation, extraction, separation, filtration, moisture control, storage, and packaging.
- The quality of coconut oil depends mainly on the maturity, freshness, and quality of coconuts used as raw material.
- Proper selection of mature coconuts improves oil yield, purity, and reduces processing defects.
- Moisture control and proper drying are important factors that influence oil shelf life and prevent rancidity.
- Virgin Coconut Oil produced through wet extraction and centrifugation gives higher purity and better nutritional quality.
- The expeller method produces higher quantity of oil but may slightly reduce quality due to heat exposure.
- Demulsification methods such as centrifugation, fermentation, and enzymatic treatment are essential for efficient oil separation.
- Pest and diseases reduce coconut yield and quality.
- Lack of finance limits modern machinery use.
- Weak branding reduces market value and sales.
- Filtration and purification improve clarity, stability, and remove impurities from coconut oil.
- Proper storage conditions such as airtight containers and controlled environments are essential to maintain quality.
- The industry faces major challenges such as seasonal availability of coconuts, price fluctuations, labour shortages, transportation issues, and machinery breakdowns.

VII. SUGGESTIONS

- Modern extraction technologies like centrifugation and enzymatic methods should be adopted to improve efficiency and quality.
- Proper planning should be done to manage seasonal fluctuations in coconut supply.
- Advanced storage systems should be used to maintain moisture control and prevent spoilage.
- Use pest control and resistant coconut varieties.

- Improve branding, packaging, and direct marketing
- Regular maintenance of machines should be done to avoid breakdowns and production delays.
- Transportation and logistics systems should be improved to reduce delays and raw material damage.
- Workers should be trained to improve efficiency and reduce production errors.
- Strict quality control systems should be followed at every stage of production.
- Stable pricing strategies should be adopted to maintain customer trust and market stability.

VIII. CONCLUSION

The study on the coconut oil industry concludes that coconut oil production is a systematic and well-structured process that involves several important stages such as raw material selection, preparation, extraction, separation, filtration, moisture control, storage, and packaging. Each stage plays a crucial role in determining the final quality, purity, aroma, and shelf life of coconut oil and virgin coconut oil. Proper management of these stages ensures better oil yield, improved stability, and higher product quality.

The study also highlights that the quality of coconut oil is highly dependent on the condition and maturity of coconuts used as raw material. Factors such as moisture content, extraction methods, and processing techniques directly influence the efficiency and output of production. Even small variations in these processes can affect the overall consistency, nutritional value, and market acceptance of the final product.

In addition, the coconut oil industry faces several operational challenges such as seasonal variation in coconut availability, raw material price fluctuations, transportation and logistics issues, labour shortages, machinery breakdowns, energy costs, and intense market competition. These challenges have a direct impact on production efficiency, cost management, and customer retention.

Overall, the study concludes that improving production technology, strengthening supply chain management, ensuring strict quality control, and adopting stable pricing strategies can significantly enhance the efficiency and sustainability of the coconut oil industry. With proper management and modernization, the industry has strong potential for growth and long-term stability.

REFERENCES

- [1] Y. J. Ng, P. E. Tham, K. S. Khoo, C. K. Cheng, K. W. Chew, and P. L. Show, "A comprehensive review on the techniques for coconut oil extraction and its application," *Bioprocess Biosyst. Eng.*, vol. 44, no. 9, pp. 1807–1818, 2021.
- [2] N. S. Prasanna, M. Selvakumar, N. Choudhary, and K. S. M. S. Raghavarao, "Virgin coconut oil: Wet production methods and food applications—a review," *Sustain. Food Technol.*, vol. 2, no. 5, pp. 1391–1408, 2024.
- [3] D. Divate, J. A. Moses, S. Anandakumar, V. R. Sinija, and N. Venkatachalapathy, "Toward sustainability in coconut processing: Current challenges, emerging concepts, and circular solutions," *Sustain. Food Technol.*, 2026.
- [4] Springer Nature, "Publisher's Note: Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations."