





Traditional vs. Modern Coconut Oil Extraction: A Systematic Review of Practices and Outcomes

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Abstract	Article History
<p>There are diverse methods of extracting oil from coconut with their level of operations, oil extraction yield, oil quality attributes, and the level of sustainability. Conventional procedures of home processing, including boiling, fermentation, and sun drying, are applied in rural areas where they are considered simple, that is, in line with local culture and economy, but have led to low yield and poor oxidative stability. This study undertook a comprehensive review of 17 peer-reviewed articles curated from scholarly databases spanning the years 2010 to 2025. The examination concentrated on juxtaposing traditional and contemporary extraction techniques in relation to oil yield, physicochemical characteristics, antioxidant efficacy, and implications for sustainability. The traditional methods demonstrated oil recovery rates between 6.3% and 61.3%, typically accompanied by elevated moisture levels and free fatty acid concentrations. In comparison, current techniques such as the enzymatic extraction technique, cold pressing, and supercritical fluid extraction (SFE) achieved yields as high as 77.7% and had improved retention of bioactive and greater oil stability. However, these sophisticated technologies usually require a large financial cost, energy cost, and the limited ability of technicians, so their applications are mostly limited to areas without sufficient resources. Although modern techniques offer improved yield and quality, their accessibility presents an ongoing challenge. The study highlights the necessity for hybrid models that amalgamate the straightforwardness of traditional methods with the effectiveness of modern technologies. Such innovations have the potential to advance sustainable, high-quality coconut oil production, aligned with the socioeconomic conditions of small-scale producers.</p> <p>Keywords: <i>Coconut oil extraction, Traditional oil extraction, Modern oil extraction, Oil yield, Virgin coconut oil, Food engineering.</i></p>	<p>Received: 23 May 2025 Accepted: 19 Jun 2025 Published: 22 Jun 2025</p>  <p>Scan the QR code to view*</p> <p>License: CC BY 4.0*</p>  <p>Open Access article</p>
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Introduction

Coconut oil, obtained from the endosperm of the coconut fruit (*Cocos nucifera*) (Idogho et al., 2025; Osman, 2019), occupies a significant role in both traditional methodologies and contemporary industries, esteemed for its multifarious applications in gastronomy, cosmetics, and pharmacology (Gray, 2018). For centuries, conventional extraction techniques have been utilized throughout tropical regions to manufacture coconut oil employing manual processes such as boiling, fermentation, or solar drying (Ng et al., 2021; Onyenanu et al., 2025). These techniques are deeply ingrained in indigenous epistemologies and continue to be essential in rural communities due to their accessibility and minimal

technological demands (Dikeogu et al., 2014; Ekpechi et al., 2023; Ekpechi et al., 2025; Erebugha et al., 2024; Eze et al., 2021). Nevertheless, the increasing requirements for elevated yield, consistent quality, and improved bioactive retention have prompted a transition towards advanced extraction technologies (OilCocos, 2024).

Traditional oil extraction methodologies, including boiling, fermentation, and solar drying, are profoundly entrenched in indigenous cultural practices (Srivastav & Karunanithi, 2024). These methodologies are distinguished by their inherent simplicity, economic feasibility, and dependence on manual labor, thereby rendering them accessible to small-scale

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producers. Nevertheless, such methods frequently culminate in reduced oil yields and variable quality (Ng et al., 2021; Ramesh et al., 2020). According to studies, conventional boiling techniques can produce oil recoveries as low as 6.3% to 10.2% with high moisture content and free fatty acid levels, which can jeopardise oxidative stability and shelf life (Musyimi et al., 2024). For example, research conducted by Ogunlade et al. (2020) indicated that traditional extraction processes yielded approximately 61.3% oil, a figure markedly inferior to that achieved through mechanical and chemical extraction techniques. Furthermore, traditional extraction methods may contribute to increased moisture content and elevated levels of free fatty acids, which in turn adversely affect the shelf life and stability of the extracted oil (Ajogun et al., 2020; Mohammed et al., 2021). In contrast, contemporary extraction methodologies have been devised to mitigate the shortcomings associated with traditional practices. These advanced techniques encompass cold pressing, centrifugation, enzymatic extraction, and supercritical fluid extraction (SFE) (Ng et al., 2021; Rohman & Indrayanto, 2024). Cold pressing, for instance, entails the mechanical pressing of fresh coconut meat without the application of heat, thereby preserving the nutritional and sensory attributes of the oil (Guo et al., 2025). Centrifugation employs centrifugal force to segregate oil from coconut milk, resulting in enhanced purity and yield (Nour et al., 2011). Enzymatic extraction utilizes specific enzymes to decompose coconut meat, thereby augmenting both oil recovery and quality (Ng et al., 2021). It has consistently yielded the highest oil recovery rates while maintaining superior physicochemical properties and antioxidant activity (Soo et al., 2020). Supercritical fluid extraction (SFE), particularly when utilizing carbon dioxide, presents a solvent-free approach that yields high-quality oil with minimal ecological repercussions (Akanda et al., 2012).

Comparative investigations have significantly underscored the numerous advantages that contemporary methodologies possess in relation to their traditional counterparts (Ng et al., 2021), thereby illuminating the progressive nature of modern techniques within various fields of study. For example, the research conducted by Ndife et al. (2019) provided compelling evidence that the process of centrifugation resulted in the maximization of oil yield, while simultaneously exhibiting markedly superior physicochemical characteristics in comparison to both fermentation and other conventional extraction techniques that have long been utilized. In a related vein, Aytac (2021) effectively illustrated that the application of supercritical fluid extraction (SFE) resulted in the production of virgin coconut oil, which possessed enhanced quality attributes that surpassed those achieved through both cold pressing and Soxhlet extraction methods, thereby highlighting the potential of innovative practices. However, notwithstanding the considerable advantages conferred by these modern techniques (Anaemeje et al., 2022; Idogho et al., 2025; Chinedu, 2024; Chukwudi et al., 2021), their widespread implementation is frequently hindered by substantial upfront capital investments, the necessity for specialized technical expertise, and the considerable energy demands associated with their operation, which collectively pose significant barriers to entry (Onyenanu et al., 2024). This situation creates formidable challenges for small-scale producers operating

within developing regions, where the continued prevalence of traditional methods can be attributed to their relative affordability and simplicity, making them more accessible to local practitioners (Ezeaku et al., 2024; Ezechukwu et al., 2025; Ikebudu et al., 2012; Ikebudu et al., 2015; Iweka et al., 2019). Consequently, there exists a pressing need to investigate and develop hybrid methodologies that effectively amalgamate the accessibility and simplicity of traditional extraction techniques with the enhanced efficiency and productivity offered by contemporary technological advancements (Vieira et al., 2024).

This review systematically assesses and juxtaposes both traditional and modern methodologies for coconut oil extraction by scrutinizing their procedural efficiencies, quality outcomes, chemical attributes, and implications for sustainability (Iweka & Owuama, 2020; Iweka et al., 2021a; Jugu et al., 2025; Ikebudu et al., 2021; O. D. K. et al., 2024; Nwankwo et al., 2012). By synthesizing insights from recent empirical investigations, this manuscript aspires to furnish a holistic overview of the merits and drawbacks inherent to each extraction methodology (Nwankwo et al., 2011; Vivian et al., 2025; Madukasi et al., 2025; Mulani et al., 2022; Nnaji et al., 2024). Furthermore, it underscores prospective avenues for the amalgamation of traditional wisdom with modern technological advancements to foster sustainable and high-quality coconut oil production across various socio-economic frameworks (Offodum et al., 2025; Okonkwo et al., 2012; Onyenanu & Nwigbo, 2021; Onyenanu et al., 2024).

Literature Review

Methods for extracting coconut oil differ greatly in terms of yield, quality, and suitability. Conventional methods like boiling, fermenting, and sun-drying are easy to use and straightforward, but they frequently lead to poor stability and little oil recovery. Ogunlade et al. (2020) observed increased amounts of free fatty acids, which decreased shelf life, while Musyimi et al. (2024) recorded yields as low as 6.3% from conventional methods. According to NIVYA et al. (2023), conventional techniques retained fewer antioxidants but produced more oil than cold centrifugation. Modern techniques, on the other hand, such as supercritical fluid extraction, enzymatic extraction, and cold pressing, show increased quality and efficiency. According to Soo et al. (2020), enzymatic extraction produced a high bioactive retention yield of 77.7%. Supercritical extraction provides improved oil purity, according to Aytac (2022). However, their application in rural areas is restricted due to their high operational costs and complexity (Onyenanu et al., 2024). Therefore, a sustainable way ahead that strikes a balance between accessibility, quality, and efficiency may be provided by combining old and new approaches.

Methodology

This study used a systematic literature review methodology to objectively evaluate the efficacy, quality outcomes, and sustainability of old and modern coconut oil extraction techniques. The review approach includes oil yield analysis, physicochemical property comparisons, antioxidant activity assessments, and process sustainability assessments. A structured search method was applied using academic

databases such as Scopus, Google Scholar, and ScienceDirect, which were chosen for their extensive coverage of food science and agricultural engineering research. Key phrases "Coconut oil extraction" AND "Traditional methods" AND "Modern techniques" AND "Oil yield" AND "Antioxidant activity" AND "Physicochemical properties" were employed in a carefully built Boolean string to narrow down the search to articles published between 2010 and 2025. In the first search, 174 documents were found. Peer-reviewed conference

papers and journal publications that offered empirical information on extraction techniques and oil properties were given priority under the inclusion criteria (Owuama & Owuama, 2021; Swift et al., 2012; Onyenanu et al., 2015; Ubani & Onyenanu, 2024; Ukwu et al., 2024; Utu et al., 2024). Studies without comparative methods, non-peer-reviewed sources, and theoretical evaluations were excluded based on certain criteria. 17 studies in all were chosen for in-depth examination following a thorough screening process.

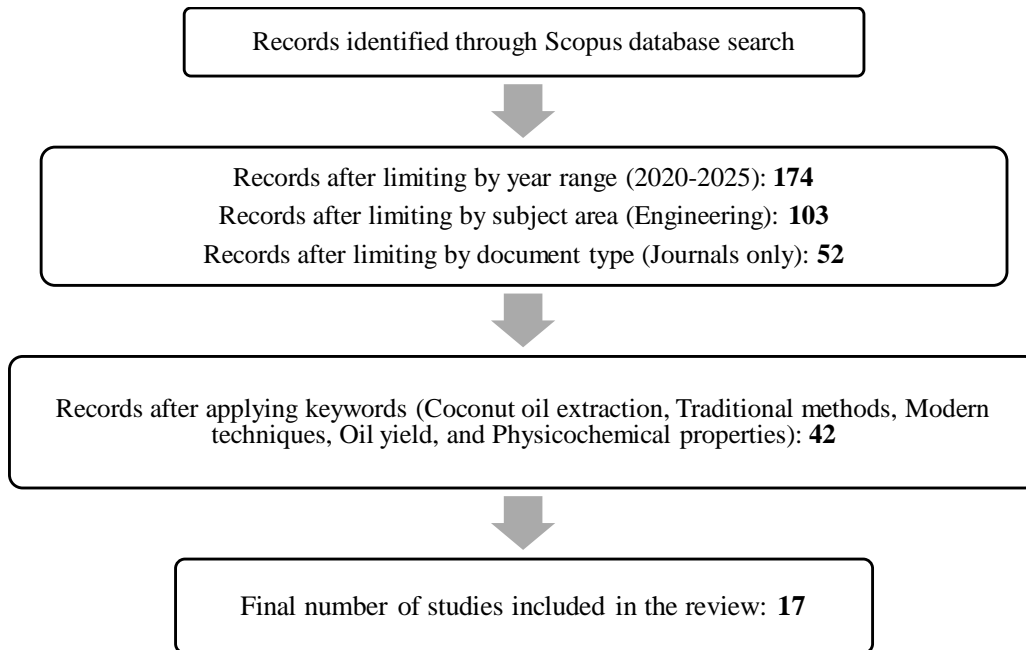


Figure 1: PRISMA Flow Diagram for Literature Selection Process

Publication of Journals by Ranking

The publication trends delineated in Figure 2 elucidate an escalating scholarly engagement with the methodologies of coconut oil extraction, particularly as a response to the burgeoning global demand for sustainable and high-yielding oil production technologies. A consistent upward trajectory in research outputs is apparent, with significant peaks occurring in the years 2020, 2023, and notably in 2025. The year 2025 is particularly significant, accounting for 17.65% of the total

reviewed publications, thereby accentuating a reinvigorated focus on the optimization of extraction methodologies through technological advancements and hybrid systems. This chronological distribution indicates a progressive transition from foundational investigations toward applied research that amalgamates traditional practices with contemporary extraction techniques.

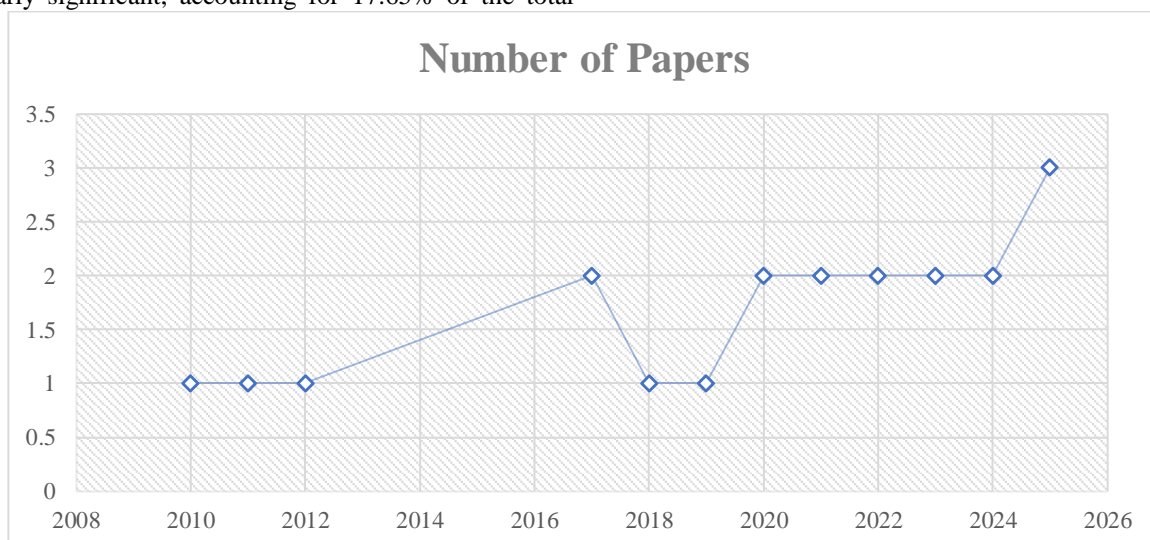


Figure 2: Journal Article by Year of Publication

Results**Overview of Coconut Virgin Oil Traditional Extraction Methods**

A structured comparative framework outlining the most conventional techniques for extracting coconut oil is shown in

Table 1. Boiling, fermentation, sun drying, and native hybrid methods like the Java crab-assisted process are some of these. Every technique has distinct operating features that affect microbial stability, oil yield, nutrient preservation, and process accessibility.

Table 1: Traditional Coconut Oil Extraction Methods

S/N	Title	Extraction Method	Key Findings	Source
1	“Evaluation of Quality of The Virgin Coconut Oil Extracted by Traditional and Cold Centrifugation Methods”	“Traditional (TVCO) and cold centrifugation (CCVCO) methods.”	“The findings revealed that there was a significant difference ($p < 0.05$) in oil recovery, content of tocopherol and total phenol, total antioxidant activity, and fatty acid profile of TVCO and CCVCO. High oil recovery and low moisture content were observed in TVCO. CCVCO contained more lauric acid (46.15%), tocopherol (26.25 g/g), total phenol content (8.87 GAE g/g), and total antioxidant activity (25.95 g/mg) than TVCO.”	(NIVYA et al., 2023)
2	“Effect Of Extraction Methods on Yield and Quality Characteristics of Coconut (Cocos Nucifera L) Oil”	“Three extraction methods (traditional, mechanical, and chemical)”	“The highest average oil yield of 82.7% (± 3.03) was obtained from the chemical extraction method using n-hexane as solvent, the mechanical extraction method gave 72.9% (± 1.49), while the lowest oil yield of 61.3% (± 2.73) was obtained from the traditional extraction method. Extraction method had a significant impact on the crude protein of the coconut oil; the highest crude protein content (2.39%) was obtained for the mechanical extraction method, while the lowest protein content, 1.68 was obtained for the chemical extraction method.”	(Ogunlade et al., 2021)
3	Characterization Of Coconut Oil (Cocos Nucifera L.) From Commonly Cultivated Kenyan Varieties Extracted by Different Methods”	“Traditional method, modified traditional method, mechanical expression, and Soxhlet method.”	“Soxhlet extraction exhibited the highest oil yield, ranging from 45.4% to 58.4%, followed by mechanical expression (39.2- 50.1%), and the least was the traditional extraction method (6.3 to 10.2%) yield, depending on variety. The quality characteristics were within Codex standards except for the high levels of free fatty acid in traditionally (0.42%) and mechanically (0.33%) extracted oil. Lauric acid was the dominant fatty acid at 47.5%- 53.5%, followed by myristic acid at 15.3-18.5%, depending on variety and the method of extraction.”	(Musyimi et al., 2024)
4	“Effect of Different Extraction Methods on the Quality and Stability of Coconut Oil”	“The traditional method 1 (Boiling and grilling for 2 hours), the traditional method 2 (cooling and grilling for 18 min), the maceration method (Hexane extraction), oven drying + pressing (Pressing 1), and finally sun drying + pressing (Pressing 2).”	“Results showed that the traditional method 1 significantly ($p < 0.05$) altered the quality of coconut oil. The best extraction methods were hexane extraction, pressing methods 1 and 2, as they preserve better the quality of coconut oil and have the highest induction and stability times. Among these, hexane extraction and pressing method 1 were the best.”	(Djikeng et al., 2018)
5	“Coconut oil extraction by the traditional Java method: An investigation of its potential application in aqueous Jatropha oil extraction”	“A traditional Java method of coconut oil extraction assisted by paddy crabs”	“However, at higher temperature (50 °C), thermophilic bacterial strains present inside crabs played a significant role in the extraction of oil from both oilseeds tested. A thermophilic bacterial strain isolated from crab paste and identified based on 16s rRNA sequence as Bacillus licheniformis strain BK23, when added as starter culture, was able to liberate 60% w/w-1 oil from aqueous J. curcas kernel slurry after 24 h at 50 °C.”	(Marasabessy et al., 2010)

Overview of Coconut Virgin Oil Traditional Extraction Methods

A structured comparative framework emphasizing cutting-edge coconut oil extraction techniques that have surfaced to overcome the shortcomings of conventional methods is presented in **Table 2**. These consist of ultrasonic-assisted

extraction (UAE), centrifugation, enzymatic extraction, cold pressing, and supercritical fluid extraction (SFE). Every contemporary technique incorporates technological innovations that enhance oil production, preserve bioactive substances, and reduce microbial contamination.

Table 2: Modern Coconut Oil Extraction Methods

S/N	Title	Extraction Focus	Key Findings	Source
1	“Enzymatic and Mechanical Extraction of Virgin Coconut Oil”	“Microwave-assisted extraction (MAE) and ultrasound-assisted extraction (UAE) methods”	“Results reveal that the enzymatic approach exhibits the highest VCO yield ($77.7\% \pm 0.38$) at $50\text{ }^\circ\text{C}$ for 2 h, followed by MAE ($58.6\% \pm 0.07$), control without enzyme ($24.1\% \pm 0.19$), and UAE ($24.1\% \pm 0.12$). The physicochemical properties of the VCOs extracted are found to conform to APCC standards, except IV. The antioxidant activity of VCO extracted with CPE shows no significant difference with the MAE and UAE methods ($p > 0.05$). Lauric acid appears to be the most abundant fatty acid detected in all VCO samples.”	(P.-P. Soo et al., 2020)
2	“Effect of different extraction methods on the quality of coconut oil”	“Mechanical, solvent extraction, and freezing (chilling and thawing) methods”	“Results revealed that the acid value, iodine value, peroxide value, and saponification value were respectively $0.25\text{mgKOH/g} - 2.04\text{mgKOH/g}$, $2.60 - 7.54\text{mgKOH/g}$, $7.28 - 9.24\text{mgKOH/g}$, and $63.31 - 217.22\text{mgKOH/g}$. The pH and thiobabutaric acid values ranged from $4.7 - 5.27$ and $1.89 - 2.35\text{ mg TBA/kg}$, each. The results were significantly ($p < 0.05$) affected by the various extraction methods. Results also showed that the oil samples were low in vitamin E ($1.4\% - 1.5\%$) and vitamin C ($3.32\% - 3.72\%$) as well as zinc ($1.33 - 1.77\text{mg/l}$), sodium ($1.94\text{mg/l} - 2.34\text{mg/l}$), and potassium ($4.22\text{mg/l} - 14.18\text{mg/l}$).”	(Ihemeje, 2023)
3	“Ethnobotany Production of Coconut Oil using Wet and Dry Methods”	“Wet and dry method”	“Producing of coconut oil using the wet method can result $15.77\% \text{ w/w}$ of yield, $11.67\% \text{ w/w}$ of protein cake, 0.06% of water content, and 0.9195g/cm^3 of oil density. While producing coconut oil using the dry method can result in $21.56\% \text{ w/w}$ of oil yield, $33.24\% \text{ w/w}$ of bagasse cake, 0.04% of water content, and 0.9191 g/cm^3 of oil density.”	(Nurma et al., 2022)
4	“Quality Evaluation of Coconut (Cocos nucifera L) Oils Produced by Different Extraction Methods”	“Natural fermentation, centrifugation, freeze-thaw, and solvent extraction protocols”	“The solvent extracted oil had the highest oil yield (23.12%), whereas fermentation oil, the lowest (14.19%). The smoke and fire points had $173.75 - 176.60\text{ }^\circ\text{C}$ and $262.45 - 266.65\text{ }^\circ\text{C}$, respectively. Solvent oil had the highest saponification (261.33 mgKOH/g) and acid values (0.77 mgKOH/g). The oils generally contained more lauric ($46.22-48.16\%$) and myristic ($18.03-19.83\%$) acids. They were also richer in vitamins A ($6.22-18.65\text{ }\mu\text{g/g}$) and E ($2.92-4.28\text{ mg/100 g}$) than D and K. Fermentation oil had the highest microbial count ($12.93 \times 10^2\text{ cfu/ml}$), whereas solvent oil had the lowest ($5.05 \times 10^2\text{ cfu/ml}$).”	(Ndife et al., 2019)
5	“Effect of Extraction Methods on the Physicochemical Properties, Fatty Acid Profile and Storage Stability of Virgin Coconut Oil (Cocos nucifera)”	“Cold and the hot process”	“The physicochemical properties of VCO from both processes were not significantly different ($P > 0.05$). Iodine value was 5.72g/100g and 6.09g/100g for cold-pressed and hot-pressed VCO, respectively. The predominant fatty acid in the coconut oil samples was lauric acid (48.76% in cold-pressed coconut oil and 49.30% in hot-pressed coconut oil). The melting point was found to increase while the smoke point decreased significantly ($P < 0.05$) for both cold pressed and hot pressed VCO after three months of storage at room temperature ($28 \pm 2\text{ }^\circ\text{C}$).”	(Ajogun et al., 2020b)

Table 2 (Cont'd)				
6	“Comparative analysis of cold-pressed and hot-pressed coconut oil extraction: Implications for quality and antioxidant capacity”	Cold-pressed and hot-pressed extraction methods	“The results revealed that cold-pressed coconut oil exhibited superior control over parameters such as acid value, peroxide value, polycyclic aromatic hydrocarbons (PAHs), and 3-monochloropropane-1,2-diol (3-MCPD) esters, along with enhanced antioxidant capacity. Lauric acid, the predominant fatty acid in coconut oil, ranged from 47.68% to 50.08% in these oils.”	(Guo et al., 2025b)
7	“Extraction Processes of Virgin Coconut Oil”	Cold and hot extraction	“The hot extractions carried out by pressing the clean, ground, and fresh coconut to yield coconut milk, followed by heating at a high temperature that could remove the useful micronutrients. In the cold process, extraction of coconut oil takes place through destabilization of coconut milk emulsion without heating, such as fermentation, chilling and thawing, centrifugation, or enzymatic treatment. Hot extraction processes have been providing better yields than cold extraction processes.”	(Agarwal, 2017)
8	“Effect of different extraction methods on physicochemical properties, antioxidant activity, of virgin coconut oil”	“Four extraction techniques: fermentation VCO (FVCO), dry VCO (DVCO), enzymatic VCO (EVCO), and the chilling and thawing VCO (CVCO) techniques.”	“Physicochemical properties of extracted VCOs were yield, 54–72%; moisture contents, 0.12–0.16%; refractive index 1.45; viscosity, 48–51 cP; free fatty acid, 0.16–0.2 g/100 g; iodine value, 4.17–7.13 g I ₂ /100 g oil; peroxide value 147–259 meq O ₂ /kg oil, and saponification value 254.10–264.04 mg of KOH/g of oil. Fatty acid composition demonstrated that lauric acid had the highest content for all the VCOs, with the range of 47.95–48.08%. The DPPH radical-scavenging activity (IC ₅₀) for the VCOs was 205.15–248.16 mg/mL, and the total phenolic content (TPC) was 37.42–68.12 mg GAE/100 mL.”	(Mohammed et al., 2021b)
9	“Effect of extraction techniques on the quality of coconut oil”	“Enzymatic, chilling and thawing, centrifugation, natural-fermentation and induced-fermentation processes.”	“The highest oil yield (83%) was from RCO, and RCO also had a significantly higher peroxide value (1.06 meq/kg oil) than VCO samples. Antioxidant activity of RCO was significantly (p<0.5) lower than that of VCO samples, with induced-fermentation having the highest antioxidant activity of 28.3%. Interestingly, enzymatic extraction resulted in a higher quantity of short-chain triglycerides. Although no method could result in a high quantity of all the tested parameters, induced-fermentation showed relatively high oil yield and antioxidant activity.”	(Oseni et al., 2017)
10	“Physicochemical properties of virgin coconut oil extracted from different processing methods”	“Fresh-dry (grated coconut route), chilling and thawing, enzymatic and fermentation method”	“The highest FA (fatty acid) is lauric acid in all of the VCO and ranged from 46.36 – 48.42 %, while the principal TAG (triacylglycerol) is LaLaLa (La: Lauric) with 17.94 – 19.83 % of the total TAG. Tocopherol analysis showed the presence of beta, gamma, and delta tocopherols at low levels. In all, the physicochemical, FA and TAG analyses of the VCO extracted from different methods showed some significant differences, while the tocopherol content does not differ significantly among the different types of extraction methods used.”	(Mansor et al., 2012)
11	“Comparison of extraction methods of virgin coconut oil: cold press, Soxhlet and supercritical fluid extraction”	“Cold press, Soxhlet, and different conditions supercritical fluid extraction (SFE)”	“The yield is in the range of 20.75%-30.23%, with the highest oil recovery gained from the Soxhlet extraction with n-hexane. Although the most efficient method is Soxhlet, when the fatty acid contents are examined, it is seen that there is not much difference in terms of lauric acid content (50.87% and 53.19%, respectively) between SFE.”	(Aytaç, 2022)
12	“Engineering intervention for production of virgin coconut oil by hot process and multivariate analysis of quality attributes of virgin coconut oil extracted by various methods”	Hot process	“The nutritionally important total phenolic content (mg GAE/100 g) and antioxidant capacity of all the VCOs were found to be in the range of 0.446 ± 0.041 (VCO-Cen) to 2.867 ± 0.152 (VCO-Hot) and 3.87 mM Trolox equivalent (TE) (VCO-Cen) to 11.31 mM TE (VCO-Hot), respectively.”	(Ramesh et al., 2020b)

Discussion

The extraction of coconut oil has progressed from rudimentary, culturally embedded practices to advanced, industrial-level technologies. This evolution signifies a growing global appetite for superior oil quality, operational efficiency, and the preservation of bioactive compounds. Traditional extraction techniques, including boiling, fermentation, and solar drying, have been employed for centuries in regions that cultivate coconuts. These methodologies are widely favored due to their inherent simplicity, cost-effectiveness, and profound connections to indigenous cultural heritage (Srivastav & Karunanithi, 2024; Osman, 2019). They hold particular significance in rural locales that lack access to mechanized processing facilities. For example, the boiling method, which is one of the most prevalent traditional techniques, remains a fundamental practice in small-scale processing environments. Nevertheless, despite these merits, traditional extraction methods are plagued by considerable drawbacks. They are often marked by limited efficiency, inadequate oil stability, and variability in quality outputs. Musyimi et al. (2024) elucidated that traditional methods are capable of yielding merely between 6.3% and 10.2% oil, accompanied by elevated levels of moisture and free fatty acids, which considerably undermines the longevity of the oil. Ogunlade et al. (2021) similarly documented that traditional extraction processes resulted in an approximate yield of only 61.3%, which is significantly inferior to the 72.9% derived from mechanical methodologies and the 82.7% attained through the application of chemical solvents such as n-hexane. In stark contrast, contemporary extraction techniques, including cold pressing, enzymatic extraction, centrifugation, and supercritical fluid extraction (SFE), are meticulously designed to enhance yield while concurrently safeguarding the nutritional and functional attributes of the oil. These methodologies have exhibited significant advancements in both oil quality and uniformity. Cold pressing, for instance, eschews the application of heat, thus preserving volatile bioactive compounds and upholding the integrity of the oil. Guo et al. (2025) ascertained that cold-pressed coconut oil demonstrated superior antioxidant capacity alongside enhanced physicochemical properties in comparison to hot-pressed counterparts. Particularly intriguing has been enzymatic extraction, which uses certain enzymes to break down coconut cell structures and promote oil release. Enzymatic techniques produced the maximum oil recovery, at 77.7%, while keeping important bioactives such as phenolic compounds and lauric acid, according to Soo et al. (2020). Aytac (2022) showed that supercritical fluid

extraction, which uses CO₂ as a solvent-free medium, delivers high yield and remarkable oil purity. They found that the approach produced oils with a higher concentration of lauric acid and less solvent residue. The production of transparent, low-moisture oils with enhanced microbiological stability has also been attributed to centrifugation-based techniques (Ndife et al., 2019).

In the context of sustainability, conventional techniques possess the merit of a minimal ecological footprint owing to their reduced energy consumption and the absence of synthetic substances. Nevertheless, these methodologies frequently entail open-air processing, which can render the product susceptible to contamination. Cold pressing and supercritical fluid extraction (SFE), albeit more environmentally benign than solvent-based extraction techniques, still necessitate electricity and specialized apparatus that may not be readily maintained in resource-limited regions. Vieira et al. (2024) underscored the criticality of harmonizing coconut oil extraction methodologies with the principles of circular economy, promoting technologies that diminish waste, energy utilization, and environmental harm. Despite their technological advancements, traditional extraction methodologies are not devoid of obstacles. Their extensive implementation is frequently limited by elevated operational expenditures, the necessity for specialized machinery, and considerable energy demands. These constraints render them impractical for smallholder producers in developing nations, who often lack the financial and technical capabilities to implement such advanced methods (Onyenanu et al., 2024). Additionally, certain modern techniques, such as Soxhlet extraction utilizing n-hexane, present environmental and safety risks associated with solvent application (Djikeng et al., 2018). Although modern methodologies yield enhanced performance, their scalability and sustainability in rural contexts continue to pose significant challenges.

Comparative Analysis

Table 3 summarises the main traditional coconut oil extraction methods covered in this paper. This summary is based on the review's overall discussion of findings, and it reflects the performance and limitations of each approach within rural, small-scale, and culturally entrenched production systems. Table 4 offers a condensed comparison of modern extraction techniques. It compiles important information on oil yields, process types, and crucial attributes such as operational complexity, antioxidant preservation, and appropriateness for commercial production.

Table 3: Traditional Coconut Oil Extraction Methods

Method	Core Process	Typical Yield	Key Characteristics
Boiling	Heating the coconut milk to separate the oil	6%–10%	Simple, widely practiced, causes nutrient degradation due to heat
Fermentation	Natural microbial separation of oil	10%–15%	Energy-efficient, high microbial count, slow process
Sun Drying	Dehydrating coconut meat, followed by manual pressing	10%–12%	Low-cost, weather-dependent, limited shelf life
Modified Traditional	Boiling plus mechanical pressing	15%–20%	Better yield than standard boiling, semi-manual process
Java Method (Crab-Aided)	Thermophilic bacteria from crab's aid fermentation	~60% (hybrid)	Niche practice, biologically enhanced, temperature-sensitive

Table 4: Modern Coconut Oil Extraction Methods

Method	Core Process	Typical Yield	Key Characteristics
Cold Pressing	Mechanical pressing without heat	50%–65%	Preserves nutrients, low oxidation, suitable for premium-grade oil
Enzymatic Extraction	Enzyme-assisted breakdown of coconut matrix	Up to 77%	High yield and antioxidant retention, precise enzyme control required
Centrifugation	High-speed spinning to separate oil from emulsion	60%–70%	High purity, fast, suitable for industrial applications
Supercritical Fluid Extraction (SFE)	CO ₂ under high pressure and temperature separates oil	65%–75%	Solvent-free, high-quality, costly infrastructure
Ultrasound-Assisted Extraction (UAE)	Acoustic waves enhance oil release	50%–60%	Energy-efficient, emerging method requires process optimization

Conclusion

This review highlights the unique benefits and limitations of both traditional and modern coconut oil extraction technologies. Traditional processes like boiling and fermenting are still culturally relevant and accessible, but they produce little oil and have poor oxidative stability. Modern procedures, including enzymatic extraction, centrifugation, and cold pressing, result in higher oil quality, yield, and bioactive retention. For example, enzymatic extraction yielded up to 77.7% with strong antioxidant preservation (Soo et al., 2020), but centrifugation produced purer oils with better microbiological stability (Ndife et al., 2019). However, these new procedures necessitate significant investment and technical skill, restricting their use in rural areas. Therefore, this study advocates the development of hybrid systems that integrate the affordability of old methods with the efficiency of current technologies. To advance sustainable coconut oil production, inclusive innovation adapted to the socioeconomic settings of coconut-producing communities is required. These solutions should prioritize local adaptability, low environmental impact, and scalability.

Conflict of Interest

The author declares no conflict of interest.

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Author contributions

All the authors contributed to the development of the work. All authors read and approved the final manuscript.

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FEATURED PUBLICATIONS

Antioxidant and Dietary Fibre Content of Noodles Produced From Wheat and Banana Peel Flour

This study found that adding banana peel flour to wheat flour can improve the nutritional value of noodles, such as increasing dietary fiber and antioxidant content, while reducing glycemic index.

DOI: <https://doi.org/10.54117/ijfnfs.v2i2.24>

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Impact of Pre-Sowing Physical Treatments on The Seed Germination Behaviour of Sorghum (*Sorghum bicolor*)

This study found that ultrasound and microwave treatments can improve the germination of sorghum grains by breaking down the seed coat and increasing water diffusion, leading to faster and more effective germination.

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