Exploring The Impact Of Temperature Variation On Coconut Seed Oil Yield

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ABSTRACT

Coconut oil is a valuable commodity with diverse applications in food, cosmetics, and pharmaceuticals. The extraction process plays a crucial role in determining the quality and yield of coconut oil. Temperature is a critical parameter that affects the efficiency of the extraction process.This study aimed to investigate the effect of temperature on coconut oil extraction using a solvent extraction method, optimizing the extraction process, and providing insights into the relationship between temperature and oil yield. A laboratory-scale solvent extraction method was employed, where coconut oil was extracted from shredded coconut at different temperatures (30°C, 40°C, 50°C, 60°C, and 70°C) using petroleum ether as the solvent. The yield of oil extracted was measured and calculated as a percentage of the initial weight of coconut used.The results showed a significant increase in oil yield with increasing temperature, with the highest yield obtained at 70°C. The yield increased from 26.29% at 30°C to 32.70% at 70°C, indicating a 24.5% increase. The study demonstrates the importance of temperature optimization in coconut oil extraction, providing valuable insights for the industry.This research contributes to the existing body of knowledge on coconut oil extraction, highlighting the potential for process optimization and improved productivity. The findings have important implications for coconut oil manufacturers, providing a basis for the development of more efficient and effective extraction processes.

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INTRODUCTION

Coconut seed oil is a valuable commodity with various industrial and culinary applications. Its production is influenced by several factors, including temperature. Temperature variation can impact the oil yield, quality, and overall efficiency of the extraction process. This study aims to investigate the effect of temperature variation on coconut seed oil yield, providing insights for optimized oil extraction and enhanced productivity..,Coconut (Cocos nucifera L.) is a widely cultivated crop in tropical regions, with its seeds being a rich source of oil. Coconut oil is a versatile product used in food, cosmetics, pharmaceuticals, and biofuels. The oil extraction process involves various methods, including mechanical pressing, solvent extraction, and cold pressing. Temperature plays a crucial role in these processes, as it can influence the oil yield, fatty acid composition, and overall quality..,Previous studies have investigated the impact of temperature on coconut oil extraction, but the focus has primarily been on the effect of high temperatures on oil quality. Limited research has explored the influence of temperature variation on oil yield, particularly in the context of coconut seed oil. Understanding the relationship between temperature and oil yield is essential for optimizing the extraction process, reducing energy consumption, and enhancing the overall efficiency of coconut seed oil production.This study aims to bridge this knowledge gap by exploring the impact of temperature variation on coconut seed oil yield, providing valuable insights for the coconut oil industry and contributing to the development of sustainable and efficient oil extraction practices.. Bhuiyan, M. A., et al. (2011).Work on the Extraction of coconut oil using enzymatic process: Effect of temperature

Coconut oil is a valuable commodity with diverse applications in food, cosmetics, pharmaceuticals, and biofuels. The global demand for coconut oil has been increasing due to its versatility and nutritional benefits. Temperature plays a crucial role in coconut oil extraction, affecting oil yield, quality, and overall efficiency. Previous studies have investigated the impact of temperature on coconut oil extraction using various methods, including enzymatic process (Bhuiyan et al., 2011), microwave-assisted extraction (Bhuiyan et al., 2015), mechanical pressing (Deshpande et al., 2013), enzyme-assisted extraction (Deshpande et al., 2015), supercritical carbon dioxide extraction (Hossain et al., 2013), and cold pressing (Kumar et al., 2014). These studies have shown that temperature significantly affects oil extraction efficiency and yield.

Despite the existing research, there is a need to further investigate the effect of temperature variation on coconut seed oil yield, particularly in the context of optimizing extraction processes for improved efficiency and sustainability. This study aims to bridge this knowledge gap by exploring the impact of temperature on coconut oil extraction and identifying the optimal temperature range for maximum oil yield.

The increasing demand for sustainable energy sources and the need to reduce dependence on fossil fuels have led to a growing interest in seed oils as a viable alternative. Optimizing coconut oil yield and quality remains a significant challenge. This research aims to investigate the effect of temperature on coconut oil extraction to determine the optimal temperature range for maximum oil yield and quality. The primary objective of this study is to investigate the impact of temperature on the yield of coconut oil extracted from coconut seeds. The specific goals are: To employ the Soxhlet extraction method for solvent extraction of oil from coconut seeds.To determine the optimal temperature range that maximizes oil yield from coconut seeds.

Justification

This research provides valuable insights into the critical parameters necessary for scaling up coconut oil production, ultimately leading to improved yields and sustainability. By identifying the optimal temperature for maximum oil extraction, this study contributes to the development of more efficient and sustainable methods for coconut oil production..

Virgin coconut oil (VCO) has gained popularity as a nutritional supplement and functional food due to its rich medium chain fatty acid profile, particularly lauric acid, which contributes to its health benefits. According to Agarwal and Bosco (2017), VCO extraction methods significantly impact oil yield and quality, with hot extraction processes providing better yields than cold extraction processes.

Key Findings from Previous Literature

a. Extraction Methods: Various methods are used to extract VCO, including solvent extraction, dry method, and wet methods, each with its advantages and disadvantages.
b. Yield and Quality: Cold extraction processes, such as fermentation and centrifugation, yield comparatively low oil content but are more environmentally friendly and preserve the oil's natural characteristics.
c. Temperature Impact: Temperature plays a crucial role in coconut oil extraction, affecting oil yield and quality. Studies have shown that optimal temperature ranges can maximize oil yield while preserving its nutritional properties [1].
d. Optimization: Research has focused on optimizing extraction processes to improve yield and quality, including the use of enzymes, supercritical carbon dioxide extraction, and aqueous enzymatic extraction.
e. Health Benefits: VCO's unique fatty acid profile and nutritional properties make it a valuable commodity in the health food market, with potential applications in cardiovascular health and nutrition.

METHOD

Materials

a. Grounded Cocus nucifera Seed (Coconut seed): Coconut seeds were used as the raw material for oil extraction. The seeds were ground into a fine powder to increase their surface area and facilitate oil extraction.
b. Petroleum ether: Petroleum ether is a solvent used for oil extraction. It is a mixture of hydrocarbons and is commonly used as a solvent in laboratories.
c. Deionized water/Distilled water: Deionized water or distilled water was used as a solvent for oil extraction and to prepare solutions.
d. Hydrochloric acid (HCl): Hydrochloric acid is a strong acid used as a catalyst in the oil extraction process.
e. Phenolphthalein indicator: Phenolphthalein is an acid-base indicator used to determine the pH of solutions.

Apparatus:

1. Soxhlet extractor (Pyrex): A Soxhlet extractor is a laboratory apparatus used for solvent extraction. It consists of a glass tube with a siphon and a heating mantle.
2. Weighing balance (Larle): A weighing balance was used to measure the weight of the coconut seed and oil extracted.
3. Heating mantle (Pyrex): A heating mantle is a laboratory apparatus used to heat the solvent in the Soxhlet extractor.
4. Retort stand (Maker): A retort stand is a laboratory apparatus used to hold the Soxhlet extractor in place.
5. Analytical Weighing Balance: An analytical weighing balance is a high-precision balance used to measure the weight of small quantities of oil extracted.
6. Laboratory dry oven (hot air oven) (DHG 901 Mode): A laboratory dry oven is a laboratory apparatus used to dry the coconut seed and oil extracted.
7. Measuring cylinder (Simax): A measuring cylinder is a laboratory apparatus used to measure the volume of solvents and solutions.
8. Beaker (Simax): A beaker is a laboratory apparatus used to mix and heat solvents and solutions.
9. Conical flask (Permagold): A conical flask is a laboratory apparatus used to mix and heat solvents and solutions.
10. Stopwatch: A stopwatch is a laboratory apparatus used to measure the time of oil extraction.
11. Burette and pipette: A burette and pipette are laboratory apparatus used to measure and transfer precise volumes of solvents and solutions.
12. Electrical grinder: An electrical grinder is a laboratory apparatus used to grind the coconut seed into a fine powder.
13. pH Meter: A pH meter is a laboratory apparatus used to measure the pH of solutions.

These materials and apparatus were used to extract oil from coconut seeds using the Soxhlet extraction method, and to determine the optimal temperature for maximum oil yield.

Sample Preparation:

1. Cocos nucifera seeds (coconut seeds) were obtained from Ariaria International Market, Aba, Abia State.
2. The coconut seeds were sliced into small pieces and left to dry for 4 days to reduce their moisture content.
3. After drying, 50 grams of the coconut seed pieces were weighed using a weighing balance and transferred to a round-bottom glass.
4. The coconut seed pieces were then subjected to Soxhlet extraction using methanol as the solvent for 3 hours.

Note: The Soxhlet extraction process involves placing the coconut seed pieces in a thimble and inserting it into the Soxhlet extractor. The methanol solvent is then added to the extractor and heated, causing the solvent to evaporate and rise into the condenser, where it is cooled and condensed back into the extractor, repeating the process for 3 hours.

Extraction of Oil from Ground Coconut Seed

The oil was extracted from the ground coconut seed using the Soxhlet apparatus. Petroleum ether, with a boiling point range of 40-60°C, was used as the extracting solvent. Procedure:

1. 200ml of petroleum ether was measured using a measuring cylinder and poured into a round-bottom flask.
2. 50g of the ground coconut seed sample was weighed and packed into the extractor column, which was then inserted into the center of the Soxhlet extractor.
3. The Soxhlet apparatus was placed on top of a heating mantle, and the heating mantle was plugged in, powered, and regulated using the side regulator.
4. The solvent was heated to its boiling point, and the vapor rose through the vertical tube into the condenser at the top.
5. The condensed liquid then dripped into the extractor column, containing the solid sample to be extracted.
6. The extract seeped through the pores of the extractor column and flowed back down into the round-bottom flask.
7. This process was allowed to continue for 2 hours and 30 minutes.
8. A thermometer was used to monitor the temperature, which was maintained at 40°C.
9. After the extraction period, the Soxhlet apparatus was removed from the heating mantle, and the round-bottom flask containing the petroleum ether and coconut oil mixture was dried in the oven to remove all traces of petroleum ether, leaving behind the coconut oil.

This extraction process using the Soxhlet apparatus allows for the efficient extraction of oil from the ground coconut seed, and the use of petroleum ether as the solvent ensures a high yield of oil. The temperature control and monitoring using a thermometer ensure that the extraction process occurs at the optimal temperature, resulting in a high-quality coconut oil.

Further extraction was conducted at 2 hours 30 minutes intervals using the same volume of petroleum ether (200ml) and 50g of the sample, but at different extraction temperatures:

a. 60°C: The extraction process was repeated at a temperature of 60°C, using the same volume of petroleum ether and sample weight, to evaluate the effect of temperature on oil yield.
b. 70°C: The extraction process was repeated at a temperature of 70°C, using the same volume of petroleum ether and sample weight, to evaluate the effect of temperature on oil yield.
c. 80°C: The extraction process was repeated at a temperature of 80°C, using the same volume of petroleum ether and sample weight, to evaluate the effect of temperature on oil yield.

By conducting the extraction process at different temperatures, the study aims to investigate the effect of temperature on the yield and quality of the coconut oil extracted.

Laboratory Analysis:

Determination of Specific Gravity Value of the Oil:

a. A 50ml specific gravity bottle was thoroughly washed with water, dried, and weighed (W1).
b. The bottle was then filled with 50ml of water and weighed again (W2).
c. The bottle was dried and filled with 50ml of the oil sample, and the weight was recorded (W3).
d. The specific gravity of the oil was calculated using the formula:

$$\text{Specific Gravity} = (W3 - W1) / (W2 - W1)$$

This procedure allows for the determination of the specific gravity of the coconut oil, which is an important physical property that can affect its behavior and uses. By comparing the specific gravity of the oil at different extraction temperatures, the study can evaluate the effect of temperature on the oil's properties.

a. A 50ml specific gravity bottle was thoroughly washed with water, dried, and weighed (M1).
b. The bottle was then filled with 50ml of water and weighed again (W2 = M1 + 50ml water).
c. The bottle was dried and filled with 50ml of the oil sample, and the weight was recorded (M2 = M1 + 50ml oil).
d. The specific gravity of the oil was calculated using the formula:

$$\text{Specific Gravity} = (M2 - M1) / (W2 - M1)$$

Using this formula, you can calculate the specific gravity of the coconut oil, which is a dimensionless quantity that represents the ratio of the density of the oil to the density of water.

Determination of Acid Value of Coconut Oil:

The acid value of coconut oil is defined as the amount of potassium hydroxide (KOH) or sodium hydroxide (NaOH) required to neutralize the free fatty acids (FFA) present in 2g of oil. This test measures the extent of enzymatic decomposition of FFA, indicating the degree of rancidity.

Procedure:

a. Weigh 2g of coconut oil into a flask.
b. Dissolve the oil in 50ml of a 1:1 (v/v) ethanol-diethyl ether mixture.
c. Titrate the solution with 0.1N NaOH using 1ml of phenolphthalein indicator.
d. Record the titre value (T).
e. Calculate the acid value using the formula:

$$\text{Acid Value} = T \times M(NaOH) \times N / W$$

Where:

T = Titre value
M (NaOH) = Molar mass of NaOH = 40 g/mol
N = Molar concentration of NaOH = 0.1 N
W = Weight of oil sample (2g)

A low acid value indicates minimal rancidity, while a high value indicates significant rancidity.

Determination of pH Value of the Oil:

The pH value of the oil indicates its relative acidity or basicity. To determine the pH, the following steps were taken:

a. 2g of the oil sample was poured into a clean, dry 25ml beaker.
b. 13ml of hot distilled water was added to the sample in the beaker and stirred slowly.
c. The mixture was then cooled in a cold water bath to 25°C.
d. The pH electrode was standardized with a buffer solution.
e. The electrode was immersed into the sample and the pH value was read and recorded.

Determination of Peroxide Value of Coconut Oil (Titrimetric Method)

The peroxide value of coconut oil was determined to assess the extent of rancidity present in the oil. This analysis was performed in a dark cupboard to prevent light-induced oxidation.

Procedure:

1. 2g of coconut oil was weighed and dissolved in a mixture of glacial acetic acid and chloroform, allowing the oil to dissolve for 1 minute.
2. 1ml of 10% potassium iodide was added and allowed to react for 1 minute in the dark.
3. 30ml of deionized water was added, causing the pink color of the potassium iodide solution to disappear.
4. 3 drops of starch indicator were added, turning the solution blue-black.
5. The resulting solution was titrated with 0.1N sodium thiosulfate solution until the blue-black color disappeared.

The peroxide value was calculated based on the volume of sodium thiosulfate used in the titration, indicating the level of rancidity in the coconut oil.

$$\text{Peroxide Value (PV)} = 100\,(V1 - V2)\,N / W$$

Where:

N = Normality of sodium thiosulfate (0.1N in this case)
W = Weight of oil used (2g in this case)
V1 = Volume of thiosulfate used in the sample
V2 = Volume of thiosulfate used in the blank (a reference sample without oil)

The peroxide value is a measure of the amount of peroxides present in the oil, which indicates the level of oxidation and rancidity. A higher peroxide value indicates a higher level of rancidity.

Determination of Iodine Value:

1. 0.4g of oil was weighed into a 250ml stoppered conical flask.
2. 10ml of carbon tetrachloride was added to dissolve the oil.
3. 20ml of Wijs' solution (a mixture of iodine monochloride and acetic acid) was added, and the stopper was moistened with potassium iodine solution.
4. The mixture was swirled and allowed to stand in the dark for 30 minutes.
5. 15ml of potassium iodine solution was added, and the stoppered bottle was shaken vigorously.

6. 1ml of 10% starch indicator was added, and the solution was titrated with 0.1N standard sodium thiosulfate solution until the blue-black color disappeared.
7. The titre value was recorded, and the iodine value was calculated using the formula:

$$\text{Iodine Value (IV)} = 12.69N\,(B-S) / W$$

Where:
N = Normality of sodium thiosulfate (0.1N)
B = Volume of sodium thiosulfate used in the blank
S = Volume of sodium thiosulfate used in the sample
W = Weight of sample used (0.4g)

The iodine value represents the amount of iodine absorbed by the oil, which indicates its degree of unsaturation. A higher iodine value indicates a higher level of unsaturation.

Determination of Saponification Value:

1. 2g of oil was weighed into a 250ml conical flask.
2. 25ml of alcoholic potassium hydroxide (KOH) solution was added, and the flask was attached to a reflux condenser.
3. The system was set up for reflux, and the mixture was heated for 30 minutes to complete saponification.
4. 1ml of phenolphthalein indicator was added to the hot soap solution, and the mixture was slowly titrated with 0.5N Hydrochloric acid (HCl) until the pink color disappeared.
5. The saponification value (SV) was calculated using the formula:

$$SV = 56.1 \times N\,(V1 - V2) / W$$

Where:
N = Normality of HCl used (0.5N)
W = Weight of oil in grams (2g)
V1 = Volume of HCl used in the sample
V2 = Volume of HCl used in the blank

The saponification value represents the amount of alkali required to saponify a given amount of oil, indicating the oil's degree of saturation and average molecular weight. A higher saponification value indicates a higher degree of saturation.

A Systematic Approach

This study employed a systematic approach to investigate the effect of temperature on coconut oil extraction. The following sections outline the step-by-step procedure:

Sample Preparation

a. Coconut Seed Selection and Drying: Coconut seeds (Cocos nucifera) were obtained from Ariaria International Market, Aba, Abia State. The seeds were sliced into small pieces and dried for 4 days to reduce moisture content.
b. Grinding: The dried coconut seeds were ground into a fine powder using an electrical grinder to increase surface area.

Oil Extraction

1. Soxhlet Extraction: A Soxhlet extractor was used for solvent extraction. Petroleum ether (boiling point 40-60°C) was used as the extracting solvent.
2. Extraction Procedure: 200ml of petroleum ether was measured and poured into a round-bottom flask. 50g of ground coconut seed sample was weighed and packed into the extractor column.
3. Temperature Control: The Soxhlet apparatus was placed on a heating mantle, and the temperature was regulated to maintain temperatures of 40°C, 60°C, 70°C, and 80°C.
4. Extraction Time: The extraction process was allowed to continue for 2 hours and 30 minutes.

Laboratory Analysis

The extracted oil was analyzed for various physicochemical properties:

Specific Gravity Determination

1. A 50ml specific gravity bottle was weighed (W1).
2. The bottle was filled with 50ml of water and weighed (W2).
3. The bottle was dried and filled with 50ml of oil sample, and the weight was recorded (W3).
4. Specific Gravity = (W3 - W1) / (W2 - W1)

Acid Value Determination

1. 2g of coconut oil was weighed into a flask.
2. The oil was dissolved in 50ml of ethanol-diethyl ether mixture.
3. The solution was titrated with 0.1N NaOH using phenolphthalein indicator.
4. Acid Value = T x M (NaOH) x N / W

pH Value Determination

1. 2g of oil sample was poured into a beaker.
2. 13ml of hot distilled water was added, and the mixture was cooled.
3. The pH electrode was standardized, and the pH value was measured.

Peroxide Value Determination

1. 2g of coconut oil was weighed and dissolved in glacial acetic acid and chloroform.
2. Potassium iodide was added, and the mixture was titrated with sodium thiosulfate.
3. Peroxide Value (PV) = 100 (V1 - V2) N / W

Iodine Value Determination

1. 0.4g of oil was weighed into a conical flask.
2. Carbon tetrachloride and Wijs' solution were added.
3. The mixture was titrated with sodium thiosulfate.
4. Iodine Value (IV) = 12.69N (B-S) / W

Saponification Value Determination

1. 2g of oil was weighed into a conical flask.
2. Alcoholic potassium hydroxide was added, and the mixture was refluxed.
3. The mixture was titrated with 0.5N HCl.
4. Saponification Value (SV) = 56.1 x N (V1 - V2) / W

This systematic approach ensured accurate and reliable results, enabling the investigation of the effect of temperature on coconut oil extraction.

RESULTS

The table presents the results of the oil extraction process at different temperatures (40°C, 50°C, 60°C, and 70°C). Here's a breakdown of the columns and what they represent:

a. Temperature (°C): The temperature at which the oil extraction was performed.
b. Weight of Sample Used (W0) (g): The initial weight of the coconut oil sample used for extraction (50g in all cases).
c. Weight of Empty Flask (W1) (g): The weight of the empty flask used for the extraction process.
d. Weight of Flask + Oil (W2) (g): The combined weight of the flask and the extracted oil.
e. Yield (%) : The percentage yield of oil extracted, calculated as (Weight of Oil / Weight of Sample Used) x 100.

The results show that:

a. As the temperature increases, the yield of oil extracted also increases, with the highest yield (32.695%) at 70°C.
b. The weight of the extracted oil (W2 - W1) increases with temperature, indicating more oil is extracted at higher temperatures.

These results suggest that higher temperatures enhance the oil extraction process, resulting in higher yields and more efficient extraction. This aligns with the research aim of investigating the effect of temperature on coconut oil extraction.

Table .1: Result of Analysis Run 1 – 70^0C.(Nnadikwe,et al)

Temperature(^{0}C)	Weight of Sample Used W_0. (g)	Weight of Empty Flask, W_1	Weight of Flask + Oil, W_2	Yield, % = $\frac{W_2 - W_1}{W_0} \times 100$	Weight of Oil $(W_2 - W_1)$
30.0	50.0	99.9366	126.2287	52.5842	26.2921
40.0	50.0	95.2767	122.3019	54.0504	27.0252
50.0	50.0	112.3458	144.1817	63.6718	31.8359
60.0	50.0	112.3458	144.4675	64.2434	32.1217
70.0	50.0	121.9783	154.6733	65.3900	32.6950

Table 2: Result of Analysis Run 2 For 30 – 70^0C(Nnadikwe,et al)

Temperature(^{0}C)	Weight of Sample Used W_0. (g)	Weight of Empty Flask, W_1	Weight of Flask + Oil, W_2	Yield, % = $\frac{W_2 - W_1}{W_0} \times 100$	Weight of Oil $(W_2 - W_1)$
30.0	50.0	99.9366	126.2278	52.5824	26.2921
40.0	50.0	95.2767	122.3210	54.0886	27.0443
50.0	50.0	112.9783	152.2837	60.6108	30.3054
60.0	50.0	112.3458	144.4683	64.2450	32.1225
70.0	50.0	121.9783	154.6837	65.4108	32.7054

The table 2, presents the results of the oil extraction process at different temperatures (30°C, 40°C, 50°C, 60°C, and 70°C) for Run 2. Here's a breakdown of the columns and what they represent:

a. Temperature (°C): The temperature at which the oil extraction was performed.
b. Weight of Sample Used (W0) (g): The initial weight of the coconut oil sample used for extraction (50g in all cases).
c. Weight of Empty Flask (W1) (g): The weight of the empty flask used for the extraction process.
d. Weight of Flask + Oil (W2) (g): The combined weight of the flask and the extracted oil.
e. Yield (%) : The percentage yield of oil extracted, calculated as (Weight of Oil / Weight of Sample Used) x 100.

The results show that:

a. The yield of oil extracted increases as the temperature increases, with the highest yield (32.7054%) at 70°C.
b. The weight of the extracted oil (W2 - W1) also increases with temperature, indicating more efficient extraction at higher temperatures.
c. The results are consistent with Run 1, confirming the trend of increased yield with temperature.

These results further support the hypothesis that temperature has a significant effect on coconut oil extraction, and highlight the importance of optimizing temperature conditions for efficient oil extraction. The results of the oil extraction process at different temperatures (30°C to 70°C) are presented in Tables 1 and 2. The findings show a consistent increase in oil yield with increasing temperature, with the highest yield achieved at 70°C.

Analysis of Results

The increase in oil yield with temperature can be attributed to the enhanced solubility of the oil in the solvent at higher temperatures. This is consistent with previous studies, which have reported similar trends (Kumar et al., 2010; Priya et al., 2010).

Comparison with Previous Studies

The optimal temperature of 70°C obtained in this study is higher than the typical temperature range of 40-60°C used in industrial coconut oil extraction. This suggests that increasing the temperature could lead to improved extraction efficiency and productivity.

Implications

The findings have important implications for the coconut oil industry, highlighting the potential benefits of optimizing extraction temperature to improve yield and efficiency.

The results of this study demonstrate the significant effect of temperature on coconut oil extraction and provide insights into the optimization of the extraction process.

Some potential areas for further discussion and analysis include:

a. Thermodynamic principles: Exploring the thermodynamic principles underlying the increased solubility of oil in solvents at higher temperatures.
b. Solvent properties: Investigating the properties of solvents that contribute to enhanced oil extraction at higher temperatures.
c. Industrial applications: Discussing the potential industrial applications of optimizing extraction temperature and the feasibility of implementing this in existing processes.

The results of this study showed a significant increase in oil yield with increasing temperature, with the highest yield obtained at 70°C. The yield increased from 26.29% at 30°C to 32.70% at 70°C, indicating a 24.5% increase. This finding is consistent with previous studies, which have reported that higher temperatures can improve oil extraction efficiency by reducing the viscosity of the solvent and increasing the solubility of the oil [1].

Linking Findings to Theories

a. Solubility Theory: The increased oil yield at higher temperatures can be attributed to the improved solubility of the oil in the solvent. As temperature increases, the solubility of the oil in the solvent also increases, allowing for more efficient extraction.
b. Viscosity Theory: The reduced viscosity of the solvent at higher temperatures enables better penetration into the coconut matrix, resulting in increased oil extraction.

Comparison with Previous Studies

a. Similar Findings: Studies by [2] and [3] also reported increased oil yields at higher temperatures, supporting the findings of this study.
b. Contrasting Findings: However, some studies have reported optimal temperatures for oil extraction below 70°C. For example, [4] found that 60°C was the optimal temperature for coconut oil extraction. These differences may be attributed to variations in extraction methods, solvents, or coconut varieties.

Implications

a. Industrial Applications: The findings of this study have important implications for coconut oil manufacturers, providing a basis for the development of more efficient and effective extraction processes.
b. Process Optimization: The study highlights the potential for process optimization and improved productivity in coconut oil extraction.

By linking the findings to relevant theories and previous studies, this discussion provides a deeper understanding of the effects of temperature on coconut oil extraction and highlights the potential for industrial applications.

CONCLUSION

This research demonstrates that temperature significantly impacts coconut oil extraction using a solvent extraction method, with optimal yield achieved at 70°C. The findings suggest that optimizing extraction temperature can improve efficiency, reduce costs, and increase productivity. To build upon this research, future studies should investigate the effects of temperature on coconut oil quality and properties, explore other optimization techniques, and examine the scalability of the optimized extraction process. Additionally, research into energy-efficient heating methods and quality control measures would further enhance the industry's productivity and product quality.

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