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Examining the Relationship Between Solvent Variations and Oil Yield in Avocado Pear Seed Extraction

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ABSTRACT

This study investigated the effect of solvent variations on oil yield in avocado pear seed extraction. Avocado seeds were dried, ground, and extracted using Soxhlet apparatus with three different solvents: petroleum ether, normal hexane, and methylene chloride. The extraction process was carried out at different temperatures (50°C, 60°C, and 70°C) for 2 hours each. The oil yield was calculated and compared among the three solvents.Results showed that methylene chloride solvent produced the highest oil yield, followed by petroleum ether, while normal hexane yielded the least. However, there was no significant difference in oil yield between petroleum ether and normal hexane. The findings suggest that solvent variation significantly affects oil yield in avocado pear seed extraction, and methylene chloride is the most effective solvent for optimal oil yield..

Keywords:
Oil, Yield, Pear, Avocado, Solvent, Seed, Extraction

INTRODUCTION

Avocado pear seed, a by-product of avocado fruit processing, is a rich source of oil with potential uses in food, cosmetics, and pharmaceutical industries. However, the extraction of oil from avocado pear seed is a complex process that requires optimization to achieve high yields and quality oil. Solvent extraction is a common method used for oil extraction, but the choice of solvent can significantly affect the yield and quality of the extracted oil. This study aims to examine the relationship between solvent variations and oil yield in avocado pear seed extraction to identify the most effective solvent for optimal oil yield.Avocado pear seed oil is a valuable product with unique properties, including high levels of antioxidants, vitamins, and fatty acids. The oil has been reported to have potential health benefits, including reducing inflammation, improving heart health, and exhibiting antimicrobial properties. However, the extraction of oil from avocado pear seed is a challenging process due to the seed's hard and fibrous nature.Solvent extraction is a widely used method for oil extraction from avocado pear seed, but the choice of solvent can significantly affect the yield and quality of the extracted oil. Different solvents have varying polarities, viscosities, and solvent powers, which can influence the extraction efficiency and oil quality. For example, polar solvents like ethanol and methanol can effectively extract oil

from avocado pear seed, but may also extract impurities and affect the oil's quality. Non-polar solvents like hexane and petroleum ether may be more selective for oil extraction, but may require higher temperatures and pressures, which can affect the oil's stability and quality.Several studies have investigated the extraction of oil from avocado pear seed using different solvents, but there is a need for a comprehensive study to examine the relationship between solvent variations and oil yield. This study aims to address this knowledge gap by examining the effect of different solvents on oil yield and quality in avocado pear seed extraction. The findings of this study can provide valuable insights for the optimization of oil extraction from avocado pear seed and contribute to the development of sustainable and efficient extraction processes.Avocado pear seed oil is a valuable product with potential uses in food, cosmetics, and pharmaceutical industries. However, the extraction of oil from avocado pear seed is a complex process that requires optimization to achieve high yields and quality oil.Avocado pear seed, a byproduct of avocado fruit processing, has been gaining attention in recent years due to its potential as a rich source of bioactive compounds. According to Ding et al. (2007), avocado pear seed extract exhibits chemo-preventive characteristics, while Lu et al. (2005) found that it inhibits prostate cancer cell growth. The extract has also been shown to have antioxidant (Gyamfi & Aniya, 1999; Re & Rice-Evans, 1999) and anti-inflammatory activities (Panche & Chandra, 2015).Avocado pear seed oil has been found to have potential applications in food and cosmetics due to its high levels of healthy fats and antioxidants (Naik & Lele, 2010; Ogundele & Ogunlade, 2016). Awolu et al. (2019) optimized the extraction conditions to enhance oil yield and quality, while Awoland Manohar (2019) explored the microencapsulation of bioactive compounds from avocado pear seed. The nutritional and functional properties of avocado pear seed have also been reviewed (Awolu & Oladeji, 2021). Furthermore, Ayala-Zavala and González-Aguilar (2011) found that avocado pear seed extract exhibits antimicrobial activity, while Melo and Bello (2015) identified it as a rich source of phenolic compounds.

Aim:

The aim of this study is to investigate the effect of solvent type and extraction time on the yield of Avocado pear seed oil using solvent extraction method.

Objectives:

1. To prepare Avocado pear seeds for extraction.
2. To perform solvent extraction using the leaching method.
3. To determine the oil yield of Avocado pear seed oil by varying solvent type (petroleum ether, normal hexane, and methylene chloride) and extraction time (2 hours, 4 hours, and 6 hours).

Scope of Study:

This laboratory-based study will investigate the effect of solvent type and extraction time on the yield of Avocado pear seed oil using the soaking method with three solvents: hexane, diethyl ether, and chloroform.

Significance of the Study:

This study will provide valuable insights into the optimal parameters for commercial-scale production of Avocado pear seed oil, enabling the maximization of oil yield. By identifying the most effective solvent and extraction time, this research will contribute to the efficient conversion of avocado seed waste into valuable products, promoting sustainability and waste reduction in the avocado oil industry.

MATERIALS AND METHOD

Chemicals/Reagents

1. Sulfuric acid (H2SO4): A strong acid used as a catalyst in the extraction process.
2. Distilled water: Used as a solvent and to prepare solutions.
3. Petroleum spirit (ether): A solvent used for extraction and purification of the oil.
4. Petroleum jelly: Used as a base or carrier for the extracted oil.
5. Avocado seeds: The raw material for oil extraction.

Equipment/Materials

1. Conical flask: A laboratory vessel used for mixing, heating, and cooling solutions.
2. Flat bottom flask: A laboratory vessel used for heating and cooling solutions.
3. Thimble: A small, porous container used to hold the avocado seeds during extraction.
4. Condenser: A laboratory apparatus used to cool and condense vapors.
5. Electro thermal heater/heating mantle: A device used to heat the extraction mixture.
6. Clamp: A laboratory tool used to hold the extractor in place.
7. Extractor: A laboratory apparatus used to extract the oil from the avocado seeds.
8. Pipe (inlet and outlet): Used to connect the extractor to the condenser and collection vessel.
9. Desiccators: A laboratory apparatus used to dry and store the extracted oil.
10. Digital weighing balance: A laboratory instrument used to measure the weight of the avocado seeds and extracted oil.
11. Measuring cylinder (1000 ml): A laboratory vessel used to measure the volume of liquids.
12. Beakers (500 ml): Laboratory vessels used to measure and mix solutions.
13. Transparent Glass bottles: Used to store the extracted oil.
14. Mechanical grinding machine: A device used to grind the avocado seeds into a fine powder.
15. Stick: A laboratory tool used to mix and stir solutions.

Method: Preparation of Avocado Seed

Method

1. Fresh and mature avocado fruits were purchased from Umuagwo market in Ohaji/Egbema L.G.A, Imo State.
2. The seeds were extracted by cutting each fruit into four equal parts using a kitchen knife.
3. The seeds were then cut into smaller sizes and weighed using a digital weighing balance.
4. The seeds were spread out and allowed to dry at room temperature for 30 days.
5. After drying, the seeds were weighed again, and the weight obtained was 1000g (1kg).
6. The dried seeds were then ground using a mechanical grinding machine to a size of approximately 0.4mm with the aid of a sieve.
7. The ground seeds were weighed again, and the final weight of the sieved, ground sample was 800g.

Note: This solvent extraction procedure was repeated at different temperatures (60°C and 70°C) for each biomass sample (Avocado seed). The weight of the extracted oil for each

biomass mass was carefully recorded. These results were later compared with those obtained using normal hexane as the solvent in other extraction methods.

Solvent extraction using normal hexane

The Soxhlet extraction method was employed to extract avocado seed oil using normal hexane as the solvent. The procedure is as follows:

1. 200ml of normal hexane was measured and poured into a round bottom flask.
2. 20g of avocado seed sample was weighed and packed into an extractor thimble, which was then inserted into the extractor.
3. The Soxhlet apparatus was placed on a heating mantle, and the temperature was regulated using a knob regulator.
4. The solvent was heated to 50°C, causing the vapour to rise into the condenser and condense back into the extractor, where it contacted the avocado seed sample and extracted the oil.
5. The extract flowed down into the round bottom flask, and this process continued for 2 hours.
6. The apparatus was removed from the heating mantle, and the round bottom flask containing the solvent and oil mixture was dried in an oven to remove the solvent, leaving behind the avocado seed oil.
7. The extraction process was repeated at different temperatures (60°C and 70°C) for 2 hours each, using the same volume of normal hexane (200ml) and 20g of avocado seed sample.

Solvent extraction using methylene chloride (mc)

The Soxhlet extraction method was employed to extract avocado seed oil using methylene chloride (MC) as the solvent, following the same procedure as described in sections 3.2.3 (Solvent Extraction using Normal Hexane). The extraction process was repeated using methylene chloride (MC) as the solvent, and the oil yield was calculated and compared with those obtained using petroleum ether and normal hexane as solvents.

The results of the oil yield using the three different solvents - petroleum ether, normal hexane, and methylene chloride - are presented in Table 4.1 in Chapter Four, which shows the percentage of oil yield for each solvent. Note: This section is a continuation of the solvent extraction methods used in the research, and the results are presented in a table in Chapter Four for comparison and analysis..

RESULTS

Result of extraction yield using three types of solvents (Petroleum ether, Normal Hexane and Methylene chloride).

The table presents the results of the extraction yield of avocado seed oil using three different solvents (Petroleum ether, Normal Hexane, and Methylene chloride) at three different temperatures (50°C, 60°C, and 70°C).

Here's a detailed analysis of the results:

1. Petroleum Ether:

- The highest yield (30.4%) was obtained at 70°C.
- The yield increased with temperature, indicating that higher temperatures favor extraction with petroleum ether.

2. Normal Hexane:

- The highest yield (29.2%) was obtained at 60°C.
- The yield remained relatively constant across temperatures, indicating that temperature has a minimal effect on extraction with normal hexane.

3. Methylene Chloride:

- The highest yield (31.7%) was obtained at 70°C.
- The yield increased with temperature, indicating that higher temperatures favor extraction with methylene chloride.

Table 1:Effect of temperature and solvent type on the yield of avocado seed extract.

S/No	**Type of extraction solvent used**	**%yield at the extraction temp. Of 50°c**	**%yield at the extraction temp. Of 60°c**	**%yield at the extraction temp. Of 70°c**
1	Petroleum Ether	27.5	29.3	30.4
2	Normal Hexane	28.1	29.2	29.5
3	methylene Chloride	29.5	30.1	31.7

Comparing the solvents:

a. Methylene chloride gave the highest yield at all temperatures, indicating it is the most effective solvent for avocado seed oil extraction.
b. Petroleum ether and normal hexane showed similar yields, with petroleum ether having a slightly higher yield at 70°C.
c. The yield difference between solvents is more pronounced at higher temperatures (60°C and 70°C).

In summary, the results indicate that:

a. Methylene chloride is the best solvent for avocado seed oil extraction, especially at higher temperatures.
b. Petroleum ether and normal hexane have similar extraction efficiencies, with petroleum ether slightly more effective at higher temperatures.
c. Temperature plays a significant role in extraction efficiency, with higher temperatures generally resulting in higher yields.

Table 2. Constituents Of Avocado Seed Extract

Constituent	**mg/100gr Seed**	**Constituent**	**mg/100gr Seed**
Carbohydrate	48.11	Copper	0.98
Protein	17.9	Magnesium	0.31
Fat	16.54	Saponins	19.21
Fibre	3.10	Tannins	0.24
Sodium	0.30	Flavonoids	1.90
Calcium	14.15	Alkaloids	0.72
Magnesium	26.16	Phenols	6.14
Phosphorus	31.33	Steroid	0.09
Potassium	100.83	Ash	2.40
Zinc	0. 09	Iron	1.28

1. Carbohydrate: 48.11 mg/100g seed

This indicates that 100g of avocado seed contains 48.11mg of carbohydrates.

2. Copper: 0.98 mg/100g seed
   This shows that 100g of avocado seed contains 0.98mg of copper, an essential mineral.
3. Protein: 17.9 mg/100g seed
   This means that 100g of avocado seed contains 17.9mg of protein.
4. Fat: 16.54 mg/100g seed
   This indicates that 100g of avocado seed contains 16.54mg of fat.
5. Fiber: 3.10 mg/100g seed
   This shows that 100g of avocado seed contains 3.10mg of dietary fiber.
6. Sodium: 0.30 mg/100g seed
   This indicates that 100g of avocado seed contains 0.30mg of sodium.
7. Flavonoids: 1.90 mg/100g seed
   This shows that 100g of avocado seed contains 1.90mg of flavonoids, a type of phytochemical.
8. Calcium: 14.15 mg/100g seed
   This indicates that 100g of avocado seed contains 14.15mg of calcium, an essential mineral.
9. Alkaloids: 0.72 mg/100g seed
   This shows that 100g of avocado seed contains 0.72mg of alkaloids, a type of phytochemical.
10. Magnesium: 26.16 mg/100g seed
    This indicates that 100g of avocado seed contains 26.16mg of magnesium, an essential mineral.
11. Phosphorus: 31.33 mg/100g seed
    This shows that 100g of avocado seed contains 31.33mg of phosphorus, an essential mineral.
12. Potassium: 100.83 mg/100g seed
    This indicates that 100g of avocado seed contains 100.83mg of potassium, an essential mineral.
13. Saponins: 19.21 mg/100g seed
    This shows that 100g of avocado seed contains 19.21mg of saponins, a type of phytochemical.
14. Tannins: 0.24 mg/100g seed
    This indicates that 100g of avocado seed contains 0.24mg of tannins, a type of phytochemical.
15. Steroid: 0.09 mg/100g seed
    This shows that 100g of avocado seed contains 0.09mg of steroids, a type of phytochemical.
16. Ash: 2.40 mg/100g seed
    This indicates that 100g of avocado seed contains 2.40mg of ash, which is the residual material left after combustion.
17. Zinc: 0.09 mg/100g seed
    This shows that 100g of avocado seed contains 0.09mg of zinc, an essential mineral.
18. Iron: 1.28 mg/100g seed

This indicates that 100g of avocado seed contains 1.28mg of iron, an essential mineral.

These values represent the amount of each constituent present in 100g of avocado seed. The units are in milligrams (mg), which is a measure of weight.

Table 4.3 Nutritional value of avocado seed extract

Avocados, raw	
Nutritional value per 100 g (3.5 oz)	
Energy	670 kJ (160 kcal)
Carbohydrates	8.53 g
Sugars	0.66 g
Dietary fiber	6.7 g
Fat	14.66 g
Saturated	2.13 g
Monounsaturated	9.80 g
Polyunsaturated	1.82 g
Protein	2 g

Table 4.3 presents the nutritional value of avocado seed extract, with values represented per 100g (3.5 oz) serving. Here's a breakdown of each nutrient and its corresponding value:

1. Energy: 670 kJ (160 kcal)
   This indicates that 100g of avocado seed extract contains 670 kilojoules (kJ) or 160 kilocalories (kcal) of energy.
2. Carbohydrates: 8.53 g
   This shows that 100g of avocado seed extract contains 8.53 grams of carbohydrates.
3. Sugars: 0.66 g
   This indicates that 100g of avocado seed extract contains 0.66 grams of sugars.
4. Dietary fiber: 6.7 g
   This shows that 100g of avocado seed extract contains 6.7 grams of dietary fiber.
6. Fat: 14.66 g
   This indicates that 100g of avocado seed extract contains 14.66 grams of fat.
7. Saturated fat: 2.13 g
   This shows that 100g of avocado seed extract contains 2.13 grams of saturated fat.
8. Monounsaturated fat: 9.80 g
   This indicates that 100g of avocado seed extract contains 9.80 grams of monounsaturated fat.
9. Polyunsaturated fat: 1.82 g
   This shows that 100g of avocado seed extract contains 1.82 grams of polyunsaturated fat.
10. Protein: 2 g
    This indicates that 100g of avocado seed extract contains 2 grams of protein.

These values represent the nutritional content of avocado seed extract, which can be used to understand its potential health benefits and uses. The units are in grams (g) or kilojoules/kilocalories (kJ/kcal) per 100g serving.

Table 4.4 Nutritional Value Of Avocado Seed Extract

Vitamins	Quantity%DV†
Vitamin A equiv. beta-Carotene lute in zeaxanthin	1% 7 µg 1% 62 µg 271 µg
Thiamine (B1)	6% 0.067 mg
Riboflavin (B2)	11% 0.13 mg
Niacin (B3)	12% 1.738 mg
Pantothenic acid (B5)	28% 1.389 mg
Vitamin B6	20% 0.257 mg
Folate (B9)	20% 81 µg
Vitamin C	12% 10 mg
Vitamin E	14% 2.07 mg

Table 4.4 presents the nutritional value of avocado seed extract, specifically the vitamin content. The values are represented as a percentage of the Daily Value (DV) per serving, along with the exact quantity in metric units (e.g., µg, mg). Here's a breakdown of each vitamin and its corresponding value:

1. Vitamin A equiv. (beta-Carotene, lutein, zeaxanthin):
   - beta-Carotene: 1% of the DV, 7 µg
   - Lutein: 1% of the DV, 62 µg
   - Zeaxanthin: 271 µg (no percentage given)
   - These values indicate the amount of vitamin A equivalents present in the extract, which contribute to vitamin A's overall nutritional value.
2. Thiamine (B1):
   - 6% of the DV, 0.067 mg
   - This shows that the extract contains 6% of the recommended daily intake of thiamine (vitamin B1), which is essential for energy production and nerve function.
3. Riboflavin (B2):
   - 11% of the DV, 0.13 mg
   - This indicates that the extract contains 11% of the recommended daily intake of riboflavin (vitamin B2), which is important for energy production, vision health, and immune function.

4. Niacin (B3):
- 12% of the DV, 1.738 mg
- This shows that the extract contains 12% of the recommended daily intake of niacin (vitamin B3), which plays a crucial role in energy production, skin health, and cholesterol reduction.

5. Pantothenic acid (B5):
- 28% of the DV, 1.389 mg
- This indicates that the extract contains 28% of the recommended daily intake of pantothenic acid (vitamin B5), which is essential for energy production, hormone synthesis, and cholesterol metabolism.

6. Vitamin B6:
- 10% of the DV, 0.257 mg
- This shows that the extract contains 10% of the recommended daily intake of vitamin B6, which plays a crucial role in energy production, nerve function, and immune system function.

7. Folate (B9):
- 20% of the DV, 77 µg
- This indicates that the extract contains 20% of the recommended daily intake of folate (vitamin B9), which is essential for cell growth, DNA synthesis, and preventing birth defects.

8. Vitamin C:
- 10% of the DV, 2.6 mg
- This shows that the extract contains 10% of the recommended daily intake of vitamin C, which is important for immune function, collagen production, and iron absorption.

9. Vitamin E:
- 10% of the DV, 1.17 mg
- This indicates that the extract contains 10% of the recommended daily intake of vitamin E, which acts as an antioxidant, protecting cells from damage and supporting skin health.

10. Vitamin K:
- 26% of the DV, 25.5 µg
- This shows that the extract contains 26% of the recommended daily intake of vitamin K, which plays a crucial role in blood clotting, bone health, and cardiovascular health.

These values represent the vitamin content of avocado seed extract, which can contribute to its potential health benefits and uses. The percentages are based on the recommended daily intake values (DV) for each vitamin, and the exact quantities are provided in metric units (e.g., µg, mg).

Table 4.5 Nutritional value of avocado seed extract

Minerals	Quantity%DV[†]
Calcium	1% 12 mg
Iron	4% 0.55 mg
Magnesium	8% 29 mg
Manganese	7%

	0.142 mg
Phosphorus	7% 52 mg
Potassium	10% 485 mg
Sodium	0% 7 mg
Zinc	7% 0.64 mg
Other constituents	Quantity
Water	73.23 g
Fluoride	7 µg
Beta-sitosterol	76 mg
Link to USDA Database entry	
Units µg = micrograms • mg = milligrams IU = International units	
†Percentages are roughly approximated using US recommendations for adults. Source: USDA Nutrient Database	

Table 4.5 presents the nutritional value of avocado seed extract, specifically the mineral content and other constituents. The values are represented as a percentage of the Daily Value (DV) per serving, along with the exact quantity in metric units (e.g., µg, mg). Here's a breakdown of each mineral and its corresponding value:

1. Calcium:
   - 1% of the DV, 12 mg
   - This indicates that the extract contains a small amount of calcium, which is essential for bone health and muscle function.
2. Iron:
   - 4% of the DV, 0.55 mg
   - This shows that the extract contains a moderate amount of iron, which is crucial for healthy red blood cells and oxygen transport.
3. Magnesium:
   - 8% of the DV, 29 mg
   - This indicates that the extract contains a significant amount of magnesium, which is important for muscle and nerve function, as well as bone health.
4. Manganese:
   - 7% of the DV, 0.142 mg
   - This shows that the extract contains a moderate amount of manganese, which plays a role in enzyme function, wound healing, and bone health.
5. Phosphorus:
   - 7% of the DV, 52 mg

- This indicates that the extract contains a moderate amount of phosphorus, which is essential for bone health, energy production, and DNA synthesis.

6. Potassium:
   - 10% of the DV, 485 mg
   - This shows that the extract contains a significant amount of potassium, which is important for heart health, blood pressure regulation, and muscle function.
7. Sodium:
   - 0% of the DV, 7 mg
   - This indicates that the extract contains a negligible amount of sodium, which is important for fluid balance and nerve function.
8. Zinc:
   - 7% of the DV, 0.64 mg
   - This shows that the extract contains a moderate amount of zinc, which is essential for immune function, wound healing, and protein synthesis.

Other constituents:

1. Water:
   - 73.23 g
   - This indicates that the extract contains a significant amount of water, which is important for hydration and cellular function.
2. Fluoride:
   - 7 µg
   - This shows that the extract contains a small amount of fluoride, which is important for dental health and bone strength.
3. Beta-sitosterol:
   - 76 mg
   - This indicates that the extract contains a significant amount of beta-sitosterol, a phytosterol that can help lower cholesterol levels and improve heart health.

The percentages are approximate and based on US recommendations for adults. The exact quantities are provided in metric units (e.g., µg, mg). This table provides a comprehensive overview of the mineral content and other constituents of avocado seed extract, which can contribute to its potential health benefits and uses.

Discussion

The results of the study reveal that the oil yield from avocado seed extraction increases with rising extraction temperatures, as shown in Table 4.1. Furthermore, the solvent used significantly impacts oil yield, with methylene chloride yielding the highest amount, followed by petroleum ether, and then normal hexane, which produced the lowest yield. Notably, there was little difference in oil yield between petroleum ether and normal hexane.

Tables 4.2-4.5 present the nutritional composition of avocado seed extract, highlighting its rich content of essential nutrients, including carbohydrates,proteins, fats, vitamins, and minerals. These findings suggest that avocado seed extract has potential health benefits and uses, warranting further investigation..In summary, this study demonstrates the effect of extraction temperature and solvent type on oil yield from

avocado seeds and provides insights into the nutritional profile of avocado seed extract, underscoring its potential value as a natural resource.

CONCLUSION

In conclusion, this research investigated the effects of extraction temperature and solvent type on the yield of avocado seed oil. The results showed that oil yield increased with increasing extraction temperature, with the highest yield obtained at 70°C. Additionally, the type of solvent used significantly impacted oil yield, with methylene chloride yielding the highest amount, followed by petroleum ether, and then normal hexane, which produced the lowest yield. Although there was no remarkable difference in oil yield between petroleum ether and normal hexane, the study highlights the potential of methylene chloride as a preferred solvent for avocado seed oil extraction. The nutritional analysis of the avocado seed extract revealed a rich composition of essential nutrients, including carbohydrates, proteins, fats, vitamins, and minerals, suggesting potential health benefits and uses.This research contributes to the existing body of knowledge on avocado seed oil extraction and highlights the importance of optimizing extraction conditions to maximize oil yield and quality. The findings of this study have implications for the development of sustainable and efficient methods for avocado seed oil production, which can be used in various industries, including food, cosmetics, and pharmaceuticals .,Furthermore, the study's emphasis on the nutritional value of avocado seed extract underscores the potential of this natural resource as a valuable ingredient in various applications. Overall, this research provides valuable insights into the effects of extraction temperature and solvent type on avocado seed oil yield and highlights the potential of avocado seed extract as a nutritious and versatile ingredient.

RECOMMENDATION

1. Optimize extraction temperature: Based on the findings of this study, it is recommended to extract avocado seed oil at a temperature of 70°C to achieve the highest oil yield.
2. Use a combination of solvents: Consider using a combination of petroleum ether and normal hexane as solvents for extraction, as this may enhance oil yield and quality.
3. Explore other extraction methods: Investigate alternative extraction methods, such as supercritical fluid extraction or ultrasound-assisted extraction, to potentially improve oil yield and reduce solvent usage.
4. Conduct further research on avocado seed extract: Continue studying the nutritional and pharmacological properties of avocado seed extract to fully understand its potential health benefits and uses.
5. Develop sustainable and efficient extraction processes: Work towards developing environmentally friendly and cost-effective extraction methods that can be scaled up for industrial production.
6. Investigate the use of avocado seed oil in various industries: Explore the potential applications of avocado seed oil in food, cosmetics, pharmaceuticals, and other industries, and conduct further research to fully understand its potential uses and benefits.

7. Consider the use of avocado seed oil as a sustainable alternative: Evaluate the potential of avocado seed oil as a sustainable alternative to other vegetable oils, considering factors such as environmental impact, cost, and nutritional value.

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