Formulation of a Topical Cream Using Virgin Coconut Oil Extracted from Pandan Coconut

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Introduction

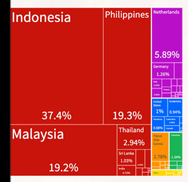

Figure 1: Leading exporter of coconut oil in 2023

Coconut varieties:

- 92.1% :Malayan Tall
- 4.3% :MATAG (Hybrid of Malayan Tall & Tagnanan Tall
- 1.7% :MATAG (Hybrid of Malayan Dwarf & West African Tall)
- 1.7% :Aromatic Type (Pandan)
- 0.2% : Malaysian Dwarf

Figure 2: Percentage of different coconut varieties grown in Malaysia

•VCO defined by the Asian and Pacific Coconut Community, is an oil gained from fresh and mature kernels of coconuts by **mechanical** or **natural methods** with or without the application of heat and no alteration of the oil's nature.

•VCO must **NOT** be **chemically refined**, **bleached** nor **deodorized** and in the natural state, suitable to consume without further needs of processing.

Objective of the Study

- To assess the effectiveness of wet extraction in preserving VCO's physicochemical properties
- To develop a stable, consumer-acceptable cream formulation incorporating VCO as the oil phase

Methodology

Selection of coconut → Preparation of coconut milk → Wet Extraction (Fermentation method) Traditional Extraction (Gentle heating method) → Assay of VCO - Peroxide Values (PV) - Saponification Values (SV) - Total Phenolic Content (TPC) *all test were done in triplicate → Formulation of Cream (W/O emulsion) → Cream Evaluation Test → End

Statistical analysis Result were expressed in mean ± sd.

- Collected from local farmer in Masjid Tanah, Melaka and authenticated at IBS,UPM.
- 30 coconuts was collected for the Pandan variety

- The selected coconuts were grated, blended with warm water and strained.

Figure 5: Extracted VCO

Fermentation Method

- A clean container was covered with parchment paper with a little air hole.
- Coconut milk was allow to stand at room temperature for 12 hours.
- The upper layer is the oil layer was pipetted out and filtered using cotton wool.
- The filtration process was repeated for two times

Figure 3: Fermentation of coconut milk

Gentle Heating Method

- The coconut milk was heated with low flame with occasional stirring.
- After all the water has been evaporated off, oil will start to separated out.
- The oil is filtered from the coconut milk curdle residue.
- The filtration process was repeated for two times.

Figure 4: Coconut milk boiling under low flame

Assays:

Peroxide value

- Sample dissolved in acetic acid-chloroform and swirled.
- Excess KI was added and swirled for 1 min.
- Distilled water was added.
- Titrated against 0.01 N sodium thiosulphate using starch as indicator (AOCS Official Methods No. Cd8-53).

Total Phenolic Content

- Folin-Ciocalteu (diluted) was mixed with samples.
- Na_2CO_3 was added and left at room temperature for 30 min.
- Mixture was tested using UV-Vis Spectrophotometer at absorbance 725 nm (Gutfinger, 1981)
- Expressed as gallic acid equivalents (GAE) per 100g oil.

Saponification value

- Sample with ethanolic KOH in conical flask connected to an air condenser was boiled until it saponified.
- After cooled, the mixture was titrated against 0.5 N HCl using phenolphthalein as indicator (AOCS Official Method No. Cd 3-25).

Figure 6: Apparatus set up for SV

Cream Formulation

- VCO and beeswax were mix together at 80°C.
- Borax and methylparaben were melted and dissolved in purified water at 80°C in another beaker
- The 2 mixtures were then mixed with constant stirring until the cream texture has become consistent.

Ingredients	Percentage (%)
VCO	25
Beeswax	50
Borax	0.6
Methylparaben	0.4
Pur. Water	24

Figure 7: Formulation of cream

Cream Evaluation Test

Test
Organoleptic
Types of smear
Removal
Dilution Test
pH
Spreadability
Irritation
Stability

Result & Discussion

Extraction Method	PV (meq O_2/kg)	SV (mg KOH/ g oil)	TPC (mg GAE/ 100 g oil)
Fermentation	1.66 ± 0.72	268.48 ± 0.38	58.32 ± 0.45
Gentle Heating	2.19 ± 0.40	259.38 ± 1.42	57.83 ± 0.11

Table 1: Physicochemical properties of tested VCO

Parameters	Result					
	Day 0		Day 7		Day 14	
Formulation	F1	F2	F1	F2	F1	F2
Organoleptic Properties	White colour with coconut aroma, smooth and thick in texture					
Types of smears	Good					
Ease of Removal	Easily washable, better with detergent					
Dilution Test	Immiscible in water (W/O emulsion					
pH	6.28	6.54	6.27	6.56	6.27	6.55
Spreadability	Uniform, 4.20 cm	Uniform, 3.20 cm	Uniform, 4.35 cm	Uniform, 3.90 cm	Uniform, 4.28 cm	Uniform, 4.30 cm
Irritation	No irritation of skin occurred					
Stability	No separation of phase was observed					

Table 2: Evaluation test of cream ; F1 = Formulation with VCO from fermentation ; F2 = Formulation with VCO from gentle heating

Peroxide Value

- **PV** measures primary oxidation of compound.
- Fermentation method VCO (1.66 meq O_2/kg) shows a lower PV compared to gentle heating method VCO (2.19 meq O_2/kg).
- This means that oil extracted by fermentation undergoes less oxidative degradation, indicating better freshness, stability, and longer shelf life.
- A **lower PV** is desirable for edible and cosmetic applications since it reflects **reduced rancidity** risk.

Saponification Value

- **SV** indicates the average molecular weight of fatty acids in the oil (higher SV = shorter chain fatty acids).
- Fermentation method VCO: 268.48 mg KOH/g oil, which is higher than Gentle heating method VCO: 259.38 mg KOH/g oil.
- This suggests that the fermentation method better **preserves medium-chain fatty acids** (MCFAs) such as lauric acid, which are known for their antimicrobial, moisturizing, and nutritional properties.
- Gentle heating may cause partial degradation or loss of shorter-chain fatty acids, slightly lowering SV.

Total Phenolic Content

- **TPC** reflects the concentration of phenolic compounds, which act as natural antioxidants.
- Fermentation method VCO (58.32 mg GAE/100 g) shows a slightly higher TPC than Gentle heating method VCO (57.83 mg GAE/100 g).
- Although the difference is small, it suggests that fermentation helps to retain more antioxidant compounds, which can enhance oxidative stability and provide health-promoting properties.

Conclusion

- VCO obtained through the fermentation method showed superior quality with lower peroxide value, higher saponification value, and slightly higher phenolic content, indicating better oxidative stability and preservation of beneficial fatty acids compared to gentle heating method.
- When incorporated into W/O cream formulations, both F1 and F2 remained stable, non-irritant, and skin-friendly over 14 days, with no phase separation and pH close to skin's natural level. F1 demonstrated better spreadability and consistent properties, making it the preferred formulation. Overall, the findings highlight **fermentation-extracted VCO** as a **superior** oil phase for developing stable and effective topical creams.

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