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Effect of Olive Oil and Almond Oil Ratios on the Physicochemical and Sensory Characteristics of Aromatherapy Massage Oil

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ABSTRACT

Background: Aromatherapy massage oil is a topical preparation in which carrier oil selection critically determines physicochemical performance and sensory acceptance. Studies evaluating olive oil and almond oil combinations as carrier oils in multi-essential oil aromatherapy systems remain limited. **Aim:** This study aimed to evaluate the effect of different olive oil (Olea europaea) and almond oil (Prunus amygdalus) ratios on the physicochemical characteristics, stability, sensory properties, and skin safety of aromatherapy massage oil containing lavender (*Lavandula angustifolia*), citronella (*Cymbopogon nardus*), and chamomile (*Matricaria recutita*) essential oils. **Methods:** Three formulations were prepared using a Completely Randomized Design (CRD) with two replications: F1 (50:5 mL), F2 (5:50 mL), and F3 (27.5:27.5 mL). Evaluations included organoleptic characteristics, pH, viscosity, specific gravity, 28-day stability, hedonic test (30 panelists), and skin irritation test (closed patch test, 10 volunteers, 8 hours), analyzed using one-way ANOVA and repeated-measures ANOVA with post-hoc Tukey HSD ($\alpha = 0.05$, SPSS v.23.0). **Results:** All formulations were stable over 28 days with consistent organoleptic properties and pH 5.00. Viscosity ranged from 4.106 ± 0.004 cP (F1) to 4.321 ± 0.004 cP (F3), all within 2.3-6.0 cP. Statistically significant viscosity changes were observed ($p < 0.05$) but were not practically meaningful. No significant difference in sensory preference was found ($p = 0.825$), with F3 descriptively obtaining the highest score (12.233). All formulations were non-irritating (ICDRG score 0). **Conclusion:** Carrier oil ratio variation influenced viscosity and specific gravity but not organoleptic stability, pH, or sensory acceptance. F3 was selected as the most optimal formulation based on combined viscosity profile, stability, and descriptive sensory preference. Limitations include short stability duration, absence of microbiological testing, and use of pH indicator paper in an oil-based system.

Keywords: massage oil, aromatherapy, olive oil, almond oil, formulation stability

INTRODUCTION

For centuries, Indonesian communities have relied on natural ingredients for healthcare and personal care purposes. Traditional therapies remain widely used because they are considered safer and associated with relatively minimal side effects compared to synthetic products. The 2018 National Basic Health Research (Riskesdas) reported that 31.4% of the Indonesian population used traditional healthcare services, while 24.6% utilized medicinal plants from household sources (Ministry of Health of the Republic of Indonesia, 2018). These figures reflect the continued and significant role of natural-based therapies within Indonesia's health system.

Aromatherapy is a rapidly growing form of complementary therapy reported to contribute to holistic well-being through topical and inhalational use of essential oils (Caballero-Gallardo et al., 2025). Essential oils are widely incorporated into topical preparations for cosmetic and personal care purposes due to their aromatic properties and biological activities (Sharmeen et al., 2021). Lavender (*Lavandula angustifolia*) has been reported to exhibit anti-inflammatory activity and modulation of the GABAergic system, although its clinical efficacy in alleviating anxiety requires further confirmation (Pandur et al., 2021; Malcolm & Tallian, 2017). Citronella (*Cymbopogon nardus*) is known to possess diverse biological activities, including antimicrobial and anti-inflammatory properties relevant to topical preparations (Bayala et al., 2020). Chamomile (*Matricaria recutita*) exhibits sedative properties attributed to its apigenin content (Sah et al., 2022). The combination of

these three essential oils, lavender (*Lavandula angustifolia*), citronella (*Cymbopogon nardus*), and chamomile (*Matricaria recutita*), is expected to provide complementary aromatherapeutic characteristics in a topical formulation; however, their clinical therapeutic effects were not evaluated in this study.

The physicochemical performance of aromatherapy massage oil is determined not only by the essential oils used but also by the carrier oil composition. Carrier oils govern critical formulation parameters, including viscosity, spreadability, skin penetration, stability, and user comfort. Plant-based oils have been shown to enhance the percutaneous penetration of active compounds into the skin (Lin et al., 2018) and contribute to skin barrier repair and hydration (Vaughn et al., 2018). Carrier oil selection, therefore, represents a fundamental decision in topical formulation development.

Previous studies have explored the use of plant-based oils as carriers in massage oil formulations. Cahyani et al. (2021) developed a hypoallergenic massage oil using extra virgin olive oil and grape seed oil, Ma'arif et al. (2023) reported an aromatherapy massage oil formulation based on Virgin Coconut Oil (VCO). However, both studies focused primarily on safety and stability assessments without systematically comparing how different carrier oil combinations at varying ratios influence overall formulation performance, particularly within a multi-essential-oil system.

A specific research gap exists in the systematic evaluation of olive oil and almond oil combinations at varying ratios within aromatherapy massage oil systems. Olive oil is rich in oleic acid, which supports emollient properties and skin penetration, while almond oil offers a lighter texture with a favorable fatty acid profile that provides improved sensory comfort and faster skin absorption (Ouzir et al., 2021). Both oils contribute to skin hydration and maintenance of the skin barrier (Noveir et al., 2024). Theoretically, olive oil dominance is expected to produce higher viscosity and enhanced penetration properties, whereas almond oil dominance is expected to yield a lighter texture with faster absorption. A balanced ratio is hypothesized to optimize both characteristics simultaneously. Nevertheless, the combined effects of these two oils on physical stability, rheological behavior, and sensory acceptance in a multi-essential-oil system containing lavender (*Lavandula angustifolia*), citronella (*Cymbopogon nardus*), and chamomile (*Matricaria recutita*) have not been adequately studied, limiting the development of evidence-based formulations that rationally consider carrier oil interactions.

The novelty of this study lies in the systematic comparison of three ratio combinations of olive oil and almond oil F1 (olive oil-dominant, 50:5 mL), F2 (almond oil-dominant, 5:50 mL), and F3 (balanced ratio, 27.5:27.5 mL) within a single aromatherapy massage oil formulation containing fixed concentrations of lavender (*Lavandula angustifolia*), citronella (*Cymbopogon nardus*), and chamomile (*Matricaria recutita*) essential oils. The F1 and F2 ratios were selected to represent the extreme conditions of each carrier oil's dominance, while F3 was designed to examine whether a balanced proportion could yield more optimal physical and sensory characteristics. Unlike previous studies limited to single carrier oil systems, this study employs a Completely Randomized Design (CRD) with two replications to evaluate the influence of carrier oil ratios on physicochemical characteristics, 28-day stability, sensory acceptance, and skin safety based on an irritation test. This study hypothesizes that different olive oil to almond oil ratios will significantly affect viscosity, specific gravity, and physical stability of the preparation, and that a balanced ratio will yield the most optimal formulation profile. This study therefore aims to evaluate the effects of olive-to-almond oil ratios on the physicochemical and sensory characteristics of aromatherapy massage oil formulated with lavender (*Lavandula angustifolia*), citronella (*Cymbopogon nardus*), and chamomile (*Matricaria recutita*) essential oils.

MATERIALS AND METHOD

Materials

Olive oil (*Olea europaea*) and almond oil (*Prunus amygdalus*) of cosmetic grade were used as carrier oils. Citronella (*Cymbopogon nardus*), lavender (*Lavandula angustifolia*), and chamomile (*Matricaria recutita*) essential oils of aromatherapy grade were obtained from PT Taromanesia, Indonesia. Supporting materials included MQuant pH indicator paper (range 0–14), sterile adhesive plasters, and distilled water.

Equipment

Equipment used included standard glassware, an analytical balance (Ohaus, 0.001 g precision), micropipettes, a pycnometer (10 mL), a thermometer, and a Brookfield viscometer (model LV, spindle no. 1).

Study Design

A Completely Randomized Design (CRD) with one factor the ratio of olive oil to almond oil was employed. Three formulations (F1, F2, F3) were prepared in two replications each. The dependent variables were organoleptic characteristics, pH, viscosity, specific gravity, 28-day physical stability, sensory acceptance, and skin irritation response. Essential oil concentrations and storage temperature (25–27°C) were kept constant across all formulations. The research procedure is presented in Figure 1.

Methods

Formulation

The total batch volume of 56.5 mL was set as the minimum required to accommodate all evaluation procedures while maintaining consistent essential oil concentrations. F1 represented olive oil dominance (50:5 mL), F2 almond oil dominance (5:50 mL), and F3 a balanced ratio (27.5:27.5 mL), as detailed in Table 1.

Table 1. Composition of Aromatherapy Massage Oil Formulations

Formula	Olive Oil (mL)	Citronella Oil (mL)	Lavender Oil (mL)	Chamomile Oil (mL)	Almond Oil (mL)	Total Volume (mL)
F1	50	0.4	0.4	0.7	5	56.5
F2	5	0.4	0.4	0.7	50	56.5
F3	27.5	0.4	0.4	0.7	27.5	56.5

Preparation Procedure

Carrier oils were measured by graduated cylinder, and essential oils by micropipette. All ingredients were combined in a glass beaker and mixed manually at 25–27°C for 5 minutes until homogeneous (Rusdianto et al., 2020). The homogeneous preparation was then transferred into amber glass bottles to protect the formulation from light-induced oxidation and stored at room temperature (25–27°C) before evaluation.

Organoleptic testing

Color, odor, and texture were assessed visually and by olfaction at day 0 and at each stability time point by two independent evaluators under consistent lighting at 25–27°C (Setiyawati & Endriyatno, 2025).

pH Test

pH was measured using indicator paper (range 0–14) immersed directly in each homogenized sample and read against the manufacturer's reference scale in triplicate (Ticoalu et al., 2024). As pH measurement in non-aqueous systems has inherent limitations, results represent a semi-quantitative approximation and should be interpreted accordingly. The accepted topical pH range is 4.5–6.5 (Lukić et al., 2021). Each formulation was measured in triplicate, and results were expressed as mean ± standard deviation (SD).

Viscosity testing

Viscosity was measured using a Brookfield viscometer (model LV, spindle no. 1, 6 rpm) at 25–27°C in triplicate and expressed as mean ± SD in centipoise (cP) (Sersemova et al., 2024). The accepted viscosity range for massage oil preparations is 2.3–6.0 (Ma'arif et al., 2023).

Specific gravity test

The specific gravity test was carried out using a pycnometer by comparing the mass of the empty pycnometer, the pycnometer filled with distilled water, and the pycnometer filled with the formulation. The density value of the preparation (g/mL) was calculated based on a pycnometer-based measurement method commonly used for liquid pharmaceutical formulations(Manek et al., 2026).

$$BJ = \frac{W_3 - W_1}{W_2 - W_1}$$

Notes:
W1: Weight of the empty pycnometer (g)
W2: Weight of the pycnometer filled with water (g)
W3: Weight of the pycnometer filled with the massage oil preparation (g) (Nabila, 2024).

Stability testing

Physical stability was observed at days 0, 1, 3, 5, 7, 14, 21, and 28 at 25–27°C. Organoleptic characteristics, pH, and viscosity were recorded at each time point and analyzed using repeated-measures ANOVA (Sarfraz et al., 2024).

Hedonic test

Sensory acceptance was evaluated using a *hedonic* test involving 30 untrained panelists (students aged 18–25 years) recruited by *purposive sampling*. Panelists were blinded to the formulation identity throughout the evaluation. Each panelist independently evaluated all three formulations based on four parameters: aroma, color, texture, and application comfort. A five-point *hedonic* scale was used: 1 = dislike, 2 = slightly like, 3 = like, 4 = very like, 5 = extremely like (Hidayati et al., 2021). The formulation with the highest total *hedonic* score across all parameters was considered the most preferred. Samples were presented in coded amber glass vials in randomized order to minimize *order bias*. Panelists were asked to cleanse their hands between samples. Data were analyzed using *one-way ANOVA* followed by *post-hoc Tukey HSD* test when significant differences were detected ($\alpha = 0.05$).

Irritation test

A *closed patch test* was conducted to evaluate the potential skin irritation of each formulation. Ten healthy adult volunteers participated in the study after giving their consent. Inclusion criteria were: healthy adults aged 18–30 years with no history of skin allergy, *atopy*, or active dermatological conditions. Exclusion criteria were: pregnant or lactating women and individuals with a history of hypersensitivity to oils or fragrances. Each formulation (approximately 0.1 mL) was applied to a sterile plaster patch and affixed to the inner forearm of each volunteer for 8 hours. Skin reactions were observed at 8 hours after patch removal and scored based on the *Draize scale*: 0 = no reaction, 1 = slight *erythema*, 2 = moderate *erythema* with edema, 3 = severe reaction (Gala et al., 2022). Formulations were classified as non-irritating if all volunteers scored 0. In the event of an adverse reaction, the patch was immediately removed, the area cleansed with distilled water, and volunteers were advised to seek medical attention if reactions persisted. It is acknowledged that the absence of formal ethical clearance and a single observation time point at 8 hours are limitations of this study; future studies are recommended to obtain institutional ethical approval and include observations at 24 and 48 hours in accordance with standard Draize protocol.

Data Analysis

One-way ANOVA compared physicochemical parameters (viscosity, specific gravity, pH) among formulations. Repeated-measures ANOVA assessed within-formulation stability changes over 28 days. Post-hoc Tukey HSD was applied only when ANOVA showed significant differences and variance homogeneity was confirmed ($p < 0.05$). All analyses used SPSS version 23.0.

RESULT AND DISCUSSION

RESULT

Organoleptic, pH, Viscosity, and Specific Gravity

All formulations (F1, F2, and F3) showed liquid form with variations in yellow color intensity and a dominant chamomile aroma. The organoleptic profile remained stable across formulations. The pH value of all formulations was constant at 5.00 ± 0.00, indicating uniform acidity across samples. All values remained within acceptable ranges for topical massage oil formulations.

Table 2. Organoleptic, pH, Viscosity, and BJ Testing

Formula	Organoleptic			pH ± SD	Viscosity ± SD (cP)	Specific Gravity ± SD
	Form	Color	Odor			
F1	Liquid	Deep light yellow	Chamomile	5.00 ± 0.00	4.106 ± 0.004	0.9094 ± 0.000
F2	Liquid	Pale light yellow	Chamomile	5.00 ± 0.00	4.118 ± 0.004	0.8966 ± 0.0004
F3	Liquid	Deep light yellow	Chamomile	5.00 ± 0.00	4.321 ± 0.004	0.9014 ± 0.0015

Notes:
F1: Olive oil 50 mL, citronella 0.4 mL, lavender 0.4 mL, chamomile 0.7 mL, almond oil 5 mL
F2: Olive oil 5 mL, citronella 0.4 mL, lavender 0.4 mL, chamomile 0.7 mL, almond oil 50 mL
F3: Olive oil 27.5 mL, citronella 0.4 mL, lavender 0.4 mL, chamomile 0.7 mL, almond oil 27.5 mL

Stability Evaluation (28 Days)

All formulations demonstrated physical stability over 28 days of storage at room temperature (25-27°C). No phase separation, precipitation, or odor changes were observed. pH remained stable at 5.00 for all formulations throughout the observation period.

Table 3. Organoleptic Stability Test

Day	Formula	Organoleptic		
		Form	Color	Odor
0–28	F1	Liquid	Deep light yellow	Chamomile
	F2	Liquid	Pale light yellow	Chamomile
	F3	Liquid	Deep light yellow	Chamomile

Table 4. Viscosity Stability Test

Formula	Viscosity (cP) ± SD								P-value
	Day 0	Day 1	Day 3	Day 5	Day 7	Day 14	Day 21	Day 28	
F1	4.106 ± 0.004	4.121 ± 0.004	4.135 ± 0.003	4.116 ± 0.004	4.146 ± 0.004	4.195 ± 0.003	4.177 ± 0.003	4.183 ± 0.003	0.004
F2	4.118 ± 0.004	4.135 ± 0.004	4.152 ± 0.003	4.158 ± 0.004	4.147 ± 0.004	4.172 ± 0.004	4.172 ± 0.004	4.187 ± 0.004	0.008
F3	4.321 ± 0.004	4.367 ± 0.004	4.367 ± 0.004	4.351 ± 0.004	4.339 ± 0.004	4.360 ± 0.004	4.387 ± 0.004	4.396 ± 0.004	0.009

Table 5. pH Stability Test

Formula	pH Value								SD
	Day 0	Day 1	Day 3	Day 5	Day 7	Day 14	Day 21	Day 28	
F1	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	0.00
F2	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	0.00
F3	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	0.00

Repeated-measures ANOVA indicated statistically significant changes ($p < 0.05$), although the magnitude of change was small.

Hedonic (Sensory) Test

Sensory evaluation involving 30 panelists showed no significant difference among formulations ($p = 0.825$).

Table 6. Hedonic Test

Hedonic test		
	Tukey HSD[a]	
Formula	N	Subset for alpha = 0.05
		1
F2	30	11.8333
F1	30	12.1667
F3	30	12.2333
Sig.		.825

F3 obtained the highest descriptive score, although differences were not statistically significant.

Skin Irritation Test

All formulations were evaluated using a closed patch test on 10 volunteers.

Table 7. Irritation Test (ICDRG Score, 8-Hour Observation)

Formula	N	Reactions Observed					Score	Description
		Erythema	Infiltration	Papule	Edema	Ulcerative		
F1	10	-	-	-	-	-	Score 0	Non irritating
F2	10	-	-	-	-	-	Score 0	Non irritating
F3	10	-	-	-	-	-	Score 0	Non irritating

Notes:
Score 0: Negative reaction (no irritation)
Score 1: Mild positive reaction (erythema, infiltration, possible papules)
Score 2: Strong positive reaction (erythema, infiltration, papules, with edema)
Score 3: Very strong reaction (ulcerative)

No erythema, edema, papules, or adverse reactions were observed. All formulations were classified as non-irritating.

Table 8. Comparative Summary for Best Formulation Selection

Criteria	F1	F2	F3
Viscosity Day 0 (cP)	4.106	4.118	4.321
Viscosity Change (cP)	+0.077 (1.87%)	+0.069 (1.68%)	+0.075 (1.74%)
pH Stability (Day 0–28)	Stable (5.00)	Stable (5.00)	Stable (5.00)
Organoleptic Stability	Stable	Stable	Stable
Specific Gravity	0.9094	0.8966	0.9014
Hedonic Mean Score	12.167	11.833	12.233
Skin Irritation (ICDRG)	Score 0	Score 0	Score 0

F3 was selected as the most optimal formulation based on a comprehensive evaluation of viscosity profile, physical stability, and descriptive sensory preference. F3 exhibited the highest initial viscosity (4.321 cP), indicating a more favorable rheological profile for massage oil application. All formulations were equally stable in organoleptic properties and pH over 28 days, and all were non-irritating. The selection of F3 was therefore based on its combined advantage rather than statistical superiority in any single parameter.

DISCUSSION

Organoleptic, pH, Viscosity, and Specific Gravity

The characterization and identification of ingredients were carried out to ensure the compatibility of the carrier oils and essential oils used in the formulation. Olive oil and almond oil were selected as carrier oils because they contain unsaturated fatty acids that act as emollients and help maintain formulation stability (Fitriani et al., 2016). Although almond oil has a relatively low viscosity, it possesses good absorption properties and provides a soothing sensation when applied to sensitive skin (Ouzir et al., 2021).

Essential oils were selected based on their bioactive constituents. Citronella (*Cymbopogon nardus*) essential oil contains citronellal, citronellol, and geraniol, which contribute to aroma

characteristics and biological activities, including antimicrobial effects (Bayala et al., 2020). Lavender (*Lavandula angustifolia*) essential oil contains linalool and linalyl acetate, which have been reported to modulate the GABAergic system, although clinical anxiolytic efficacy requires further confirmation (Malcolm & Tallian, 2017). Chamomile (*Matricaria recutita*) essential oil exhibits mild sedative properties attributed to apigenin, which interacts with GABA receptors (Sah et al., 2022). The combination of these essential oils is expected to provide complementary aromatherapeutic characteristics in topical application, although clinical therapeutic effects were not evaluated in this study.

All formulations appeared as clear liquids with yellow color variations and a dominant chamomile aroma. Differences in carrier oil ratio influenced color intensity, where a higher proportion of olive oil produced a deeper yellow appearance in F1 and F3, while F2, which was almond oil-dominant, exhibited a paler yellow color. This is consistent with Sharmeen et al. (2021), who reported that visual and aroma characteristics of essential oil formulations are influenced by carrier oil compatibility and volatility profile. The dominant chamomile aroma across all formulations suggests that chamomile essential oil, at 0.7 mL, contributed the most prominent olfactory characteristic among the three essential oils used.

All formulations produced a pH value of 5.00, which falls within the physiological skin pH range of 4.5–6.5 (Lukić et al., 2021), indicating compatibility with skin conditions and low irritation potential. The SD of 0.00 across all formulations reflects the inherent resolution limitation of pH indicator paper in non-aqueous oil-based systems rather than absolute pH constancy. A more sensitive validated method, such as a calibrated pH meter with a flat-surface electrode, is recommended in future studies.

Viscosity values of F1, F2, and F3 were 4.106 ± 0.004 cP, 4.118 ± 0.004 cP, and 4.321 ± 0.004 cP, respectively. All formulations fall within the acceptable viscosity range for massage oil preparations of 2.3–6.0 cP (Ma'arif et al., 2023). F3 exhibited the highest viscosity, which may be attributed to the balanced interaction between olive oil and almond oil fatty acid profiles. Olive oil, with its higher oleic acid content, tends to produce a more viscous phase, and its balanced combination with almond oil in F3 may have improved the internal structural consistency of the lipid-based system (Sarfraz et al., 2024). The viscosity values obtained indicate that variations in the ratio of olive oil and almond oil influenced the rheological characteristics of the massage oil while maintaining viscosity within the acceptable range for topical application.

Specific gravity values ranged from 0.8966 ± 0.0004 (F2) to 0.9094 ± 0.0000 (F1), all within the acceptable range for topical oil formulations of 0.69–1.18 (Aryani et al., 2020). The SD value of 0.0000 for F1 reflects measurement consistency at the precision level of the *pycnometer* used. These results indicate uniform density behavior and absence of phase instability across all formulations.

Stability Evaluation (28 Days)

All formulations remained stable throughout the 28-day storage period with no observable changes in physical form, color, or odor. No phase separation, precipitation, or rancid odor was detected, indicating good physical stability. These findings are consistent with Sharmeen et al. (2021), who reported that essential oils with lower volatility and good compatibility with carrier oils tend to maintain *organoleptic* stability during storage.

Repeated-measures ANOVA revealed statistically significant viscosity changes over 28 days for all formulations: F1 ($p = 0.004$), F2 ($p = 0.008$), and F3 ($p = 0.009$). However, it is important to distinguish statistical significance from practical significance. The absolute viscosity changes were minimal: F1 increased by 0.077 cP (1.87%), F2 by 0.069 cP (1.68%), and F3 by 0.075 cP (1.74%) over 28 days. All values remained consistently within the acceptable viscosity range of 2.3-6.0 cP throughout the entire observation period (Ma'arif et al., 2023). These findings indicate that while statistically detectable, the viscosity changes are not practically meaningful in terms of formulation performance or user experience, consistent with Sarfraz et al. (2024), who explained that slight viscosity increases during storage in oil-based formulations may occur due to progressive interactions among lipid components.

All formulations maintained a constant pH of 5.00 throughout the 28-day observation period, remaining within the physiological skin pH range of 4.5-6.5 (Lukić et al., 2021). The constant pH values indicate good chemical stability of the formulations during storage and suggest that no significant acid-base reactions occurred between the carrier oils and essential oils during the observation period. As previously noted, the SD of 0.00 reflects a measurement limitation of pH indicator paper in *non-aqueous* systems rather than absolute certainty of pH constancy; a validated instrumental method is recommended for future studies.

Hedonic (Sensory) Test

The hedonic test showed no statistically significant difference in panelist preferences among formulations ($p = 0.825 > 0.05$), indicating that carrier oil ratio variation did not significantly influence overall sensory acceptance. No formulation can therefore be claimed as statistically superior in sensory preference. Nevertheless, F3 descriptively obtained the highest mean hedonic score (12.233), suggesting that a balanced composition of olive oil and almond oil may contribute positively to texture, aroma, and application comfort. This descriptive tendency should be interpreted cautiously as it is not supported by statistical evidence of superiority.

Skin Irritation Test

All formulations produced an ICDRG score of 0 at the 8-hour observation point, confirming the absence of erythema, papules, edema, infiltration, or ulcerative reactions. These findings confirm that all formulations were safe for topical application under the conditions of this study, consistent with the known tolerability profile of cosmetic-grade olive oil and almond oil in topical preparations (Noveir et al., 2024).

CONCLUSION

This study demonstrated that variations in olive oil and almond oil ratios significantly influenced viscosity and specific gravity, while organoleptic characteristics, pH stability, and sensory acceptance were not significantly affected. All three formulations remained physically stable over 28 days of storage with consistent organoleptic properties, stable pH of 5.00, and viscosity values within the acceptable range of 2.3–6.0 cP. Although statistically significant viscosity changes were detected during storage ($p < 0.05$), these were not practically meaningful as all values remained within acceptable limits. No statistically significant difference in sensory preference was found among formulations ($p = 0.825$), and all were classified as non-irritating based on a closed patch test (ICDRG score 0). F3, containing a balanced ratio of olive oil and almond oil (27.5:27.5 mL), was selected as the most optimal formulation based on its combined advantage in viscosity profile, physical stability, and descriptive sensory preference, rather than statistical superiority in any single parameter. Future studies are recommended to address the limitations of this study, including the short 28-day stability duration, absence of microbiological and oxidation testing, limited pH measurement precision in oil-based systems, and the need for clinical efficacy evaluation.

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