Original Article

The comparison of skin irritation level between topical cajeput oil and telon oil: A pilot study

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Abstract

Background: Cajeput/Cajeput/Melaleuca leucadendron oil is a type of essential oil, widely known and used by Indonesian for infants, children, and elderly. It is also included in telon oil compositions (±42%). Excessive application of cajeput oil and telon oil may lead to skin irritation.

Methods: This randomized single-blind control trial was conducted with 10 subjects who met the inclusion criteria. Four areas with diameter of 10 mm each were made on the flexor surface of the upper arm. Area 1 was designated as negative control. Area 2 to 4 were pre-irritated with tape stripping for 40 ± 10 times using Nachitape®, followed by repeated open application test (ROAT) with cajeput oil, telon oil and alcohol (positive control). The skin irritation was examined in 15 minutes after each cycle by measuring transepidermal water loss (TEWL) using Tewameter® TM300 ( Courage-Khazaka, Germany) and erythema using Mexameter® MDD4. Data were analyzed using One-way ANOVA with p<0.05 considered significance.

Results: The average TEWL and erythema of cajeput oil (15.59; 345.42) were the highest compared to telon oil (12.63; 316.60), alcohol (13.87; 319.06) and negative control (7.48; 296.68). All treatment groups had significant differences in TEWL (p<0.000) and erythema (p<0.002) when compared to the negative control. However, cajeput oil showed the largest difference.

Conclusion: Cajeput oil caused the most irritation compared to alcohol and telon oil. Therefore, it should be used with caution.

Keywords: cajeput oil, essential oil, skin irritation, telon oil

Background

Cajeput/Cajeput/Melaleuca leucadendron oil, known as “minyak kayu putih” in Indonesia, and telon oil are widely used by Indonesian people to warm infant, children and elderly. Telon oil contains cajeput oil (42%), oleum Anisi 8% and oleum Cocos 50%.1 Irritant contact dermatitis is one of skin diseases, which possibly emerges due to essential oil.2 In two reports published by Noosidum et al., it was concluded that cajeput oil may cause skin irritation. The excessive use of cajeput oil or telon oil can lead to skin irritation or skin rash.5 Two factors, that affect this condition, are cajeput oil concentration and skin’s susceptibility or sensitivity towards irritant. Pure cajeput oil has different concentration compared to mix cajeput oil, such as telon oil. Higher concentration of cajeput oil leads to higher possibility of skin irritation.4

To date, there are lot of studies related to this oil and other similar types of essential oil.7-14 There are three studies which had assessed skin irritation level and toxicity caused by the application of tea tree oil (Melaleuca alternifolia).12-14 However, study about skin irritation level related to the application of cajeput oil and telon oil has not been done before. We hope the results of this study can be used as recommendation to educate cajeput oil and telon oil users, including children or adult, as well as to increase awareness of potential skin irritation caused by cajeput and telon oil.
Methods

This randomized single-blind control trial was conducted using tape stripping to get pre-irritation condition, followed by repeated open application test (ROAT) of cajeput and telon oil. This study has been approved by Health Research Ethics Committee of Dr. Moewardi General Hospital, Surakarta, Indonesia at May 4th 2016.

The subjects were chosen randomly in Department of Dermato-Venereology, Dr. Moewardi General Hospital. There were 10 people, who met the inclusion criteria and did not meet the exclusion criteria, i.e. healthy skin (there was no skin lesion in their body), no history of atopy or allergy, and signing the inform consent for the study. In addition, there was no exposure of any emollients or detergents on subject's skin during the study.

Procedure

We made four circular areas with diameter 10 mm each on the flexor side of upper arm. Each area was numbered 1 to 4, followed by measurement of transepidermal water loss (TEWL) and erythema for each area. TEWL measurement was conducted using Tewameter® TM 300 (Courage-Khazaka, Germany), whereas erythema measurement was conducted using Mexameter® MDD4 (S0).

Tape stripping were done in area 2, 3, and 4 40 ± 10 times using Nachitape® to get pre-irritation condition, followed by ROAT method. Cajeput oil (oleum cajuputi 100%) and telon oil (oleum cajuputi 42%, oleum anisi 8%, oleum cocos 50%) were smeared slowly on area 2 and 3, respectively, for 10 times using cotton stick to prevent and minimize mechanical stimulation. Area 4 was smeared with 70% alcohol, as positive control, with the same method as area 2 and 3 right before measurement of TEWL and erythema. After 15 minutes (one cycle), TEWL and erythema condition of each area were measured (S1). Same procedures were repeated twice for the second and the third cycle (S2-S3). Area number 1 was negative control without tape stripping and ROAT.

Statistical Analysis

The irritation level in each group was compared with negative control. Furthermore, every collected data (S1, S2, S3) is compared and analyzed using one-way ANOVA, followed with Games-Howell test if the data were not homogeneous or Bonferroni test if the data were homogeneous, with p<0.05 considered significance.

Results

After tape stripping, the TEWL scores of cajeput oil, telon oil and alcohol group were increased when compared to S0. TEWL measurement in S1, S2, and S3 showed that cajeput oil group had average TEWL (15.59) higher than telon oil (12.63), positive control (13.87) and negative control (7.48) groups (Figure 1). In addition, erythema examination (S1, S2, S3) showed cajeput oil group had erythema score (345.42) higher than telon oil (319.06) and negative control (296.68) groups (Figure 2). According to one-way ANOVA, all groups had significant differences of TEWL and erythema (S1, S2, S3) with p=0.000 and p=0.002, respectively.

![Figure 1](#)

Figure 1. Skin irritation level in each group on every cycles, represented by TEWL measurement using Tewameter
Furthermore, post-hoc test was conducted to compare the treatment groups. Games-Howell test was used for TEWL measurement. It showed that all treatment groups had significant differences compared to negative control, whereas cajeput oil showed the largest differences. Moreover, Bonferroni test of erythema measurement showed significant difference only for cajeput oil compared to negative control. Thus, it can be concluded that cajeput oil was the most irritative oil compared to alcohol and telon oil.

![Figure 2](image.png)

**Figure 2.** Skin irritation level in each group on every cycle, represented by erythema measurement using Mexameter.

**Discussion**

*Melaleuca* has more than 100 species; it is an essential source of oil in Australia and South-East Asia. *Melaleuca leucodendra* is the most common source for cajeput oil in North Australia, Indonesia, Papua New Guinea, Thailand and Vietnam. Cajeput oil is obtained from refining process of cajeput leaves and twigs. This tree has white coated and layered stem with small leaves and distinctive scent. Indonesian usually use Cajeput oil as traditional medicine.\(^1\) This is supported by many studies, which showed that this oil is used to relieve neuralgia, headache and dental pain; as antioxidant, antiviral, antimicrobial and antiseptic; to treat wound, herpes, furuncle, fungal infections; and as insect repellent.\(^1,3,4,7,10,11,18,22\)

Cajeput oil contains various chemicals, which are 1,8-pinene, \(\delta\)-pinene, \(\beta\)-myrcene, limonene, 1,8-cineole, \(\gamma\)-terpinene, \(\gamma\)-cymene, terpinolene, benzaldehyde, linalool, terpinal-4-ol, \(\alpha\)-terpinolol 1-tetradesene, valencene, \(\alpha\)-eudesmol and \(\beta\)-eudesmol. The major chemical compound found in pure cajeput oil is 1,8-cineole (55-64.3\%).\(^1,7,18\) This chemical is also the main component in other essential oils, such as eucalyptus, tea tree, rosemary and olbas oil.\(^18\) Pino et al. had analyzed the effects of those chemicals, particularly 1,8-cineole, which was obtained from leaves and fruits, showing that cajeput oil has high antioxidant effects.\(^22\) Sadlon AE et al., who studied eucalyptus oil, found that 1,8-cineole, which inhibits or reduces tumor necrosis factor-alpha (TNF-\(\alpha\)), interleukin (IL)-1\(\beta\), IL4, IL5, IL6, IL8, prostaglandin E2 (PGE2), thromboxane B2 (TxB2), affects monocytes/macrophages, decreases early growth response factor-1 (Egr-1) expression and has no effect on *nuclear factor \(\kappa\beta\)* (NF-\(\kappa\beta\)).\(^19\)

Study about skin irritation level related to the application of cajeput oil and telon oil has not been done before. Noosidum et al., in their study about the effectiveness of cajeput oil as repellent, found that cajeput oil might cause skin irritation. However, they did not assess the irritation level.\(^3,4\) Hammer et al. reported that the chronic use of tea tree oil containing 1,8-cineole on skin might cause irritation or sensitization such as erythema, acute eczema, and itching.\(^12\) On the other hand, former study by Southwell et al. found that there was no skin irritation in all 1,8-cineole concentration which was mixed with vaseline album.\(^13\) According to Trisnarizki et al., vaseline album has a huge occlusive capacity which was presented by the decrease of TEWL from Tewameter measurement. Moreover, its use was rarely reported to induce allergy sensitization or irritation.\(^23,24\)
Contact irritant dermatitis (CID) is a skin inflammatory disorder, which occurs without hypersensitivity reaction and is caused by contact with chemical, physical, or biological agents. The manifestation was based on the irritant molecule size, solubility, concentration, vehicle, temperature and other factors, such as duration of contact, frequency, occlusion, friction or physical trauma. Individual factors also take part, for example skin thickness, race, gender, and history of skin diseases. To control those factors, this study was conducted with few methods of non-invasive examination such as tape stripping, ROAT, Tewameter and Mexameter in accordance with the standards of the examination.

Tape stripping is aimed to induce pre-irritation, leading to reduction of stratum corneum thickness, thus the topical drugs can easily reach the deeper tissue. Pre-irritation method is influenced by adhesion, strength while stretching/releasing tape stripping, and intrinsic factors of the skin itself which ultimately affect the amount of drugs/chemicals penetration. Skin intrinsic factor includes anatomical location which in this study was flexor part of upper arm, needs 30-40 times of stripping to reduce stratum corneum. This method was chosen because the procedure can be conducted in a day.

Repeat open application test is a simple way, to do repeated exposure and is often used to predict the irritation level, especially in ingredients with weak irritant potency, cosmetics and insect repellent. The irritation level was represented by TEWL and erythema. Transepidermal water loss or erythema has been used as an indicator to assess the presence of irritation and damage in skin barrier. TEWL examination is affected by anatomical location, room temperature, use of lotions, moisturizers, soaps and cosmetics. Post pre-irritation with tape stripping was associated with increase differences among TEWL for different body locations. The increase was 16 ± 7.6 g / m².h on the arms.

In this study, all groups had positive increase of TEWL (Figure 1). Based on these data, significant differences were found in all groups compared to the negative control, and cajeput oil had the largest differences. On erythema measurement, the only significant difference was shown in cajeput oil group compared to the negative control. Figure 2 showed that the erythema in ROAT of cajeput oil group increased from 350 mJ/cm² (S1) to 370 mJ/cm² (S3). However, neither positive control group nor the telon oil group had any increases. This meant that erythema in cajeput oil group remained to be found, although the erythema was not visible, and this finding indicated skin irritation.

**Conclusion**

Cajeput oil irritates more than alcohol and telon oil. The result showed conformity with the theory that the higher concentration of cajeput oil, the higher possibility of skin irritation. Therefore, cajeput should be used with caution. Further study is needed with more subjects to provide more valid result.

**References**


