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Eucalyptus oil: contact allergy and safety

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Many traditional plant-derived products are now being used in non-traditional ways. This raises questions about accessibility, regulation, determination of appropriate dosing, and hazards associated with their use. One example is eucalyptus oil. Eucalyptus oil has been used medicinally for over a century (1), but there is now increasing interest in its 'natural' antimicrobial properties. The public perception of eucalyptus oil as a safe and 'organic' preparation contrasts with the not insubstantial hazard that the oil poses in pure form (1). We performed literature reviews for both contact allergy and safety. During our analysis, a case report of allergic contact dermatitis (ACD) caused by the eucalyptus plant was published, concluding that ACD caused by eucalyptus may be underreported in the literature (2). It is therefore timely to review our results of patch testing with eucalyptus oil over a 20-year period.

Current and Historical Usage, and Retrospective Review

Eucalyptus oil is claimed to have antibacterial, antiviral, antifungal, anti-inflammatory and insect-repellent activities (3–5). It has become a common ingredient in topical antiseptics, liniments, soaps, dental mouthwashes, and lozenges, balms and inhalants for colds and flu. It is widely used in aromatherapy and in industrial and domestic cleaning products. It now has new uses, such as in hand hygiene and cleaning wipes. Eucalyptus oil is steam distilled from the leaves of select species of *Eucalyptus*, a genus of the plant family Myrtaceae. The principal constituent of pharmaceutical-grade eucalyptus oil is 1,8-cineole (eucalyptol), a monocyclic monoterpene ether comprising 70–90% of the volume. Other constituents include α-pinene, limonene, cuminyl aldehyde, α-phellandrene, *p*-cymene, *trans*-pinocarveol, and terpinen-4-ol (the main constituent in tea tree oil) (6). The majority of the world's pharmaceutical-grade eucalyptus oil is produced by China, with Europe being the largest importer (7).

We retrospectively reviewed our patch testing data at the Skin and Cancer Foundation over the period 1 January 1993 to 31 December 2013. There were 596 patients patch tested with 5% eucalyptus oil in pet., of 8334 patients patch tested over this period. The eucalyptus oil was purchased commercially as 100% (CAS no. 8000-48-4), and diluted to 5% in pet. by a pharmacist. We identified 2 positive reactions in those tested specifically with 5% eucalyptus oil (prevalence 0.34% of those tested); however, the relevance of these reactions was not established. There was also a documented case of a florist with ACD caused by the leaves of *Eucalyptus globulus* (blue gum) who was not tested with eucalyptus oil. A review of 9 years of patch testing data from the Information Network of Departments of Dermatology showed 17 of 6680 positive reactions (prevalence 0.25%) to 2% eucalyptus oil (6), which is comparable to our findings. In addition, 3 of 200 positive reactions (1.5%) to 2% eucalyptus oil were reported in 1976 (8). A prospective study in 747 patients with suspected fragrance allergy undergoing extended fragrance testing showed 4 of 747 positive reactions (0.6%) to 2% eucalyptus oil (9). A similar study in 218 fragrance-sensitive patients showed a higher rate of positive reactions in this group: 1.8% (4/218) to 10% eucalyptus oil (10). Individual literature reports include a case of airborne ACD in a patient exposed to multiple topical and vaporized aromatherapy oils who reacted to 2% eucalyptus oil (11), a report of ACD in a patient using anti-inflammatory cream who reacted to 1% eucalyptus

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oil (12), and a case of systemic allergic dermatitis caused by tea tree oil where the patient reacted to 5% 1,8-cineole (eucalyptol) (13).

Discussion

It appears that, when applied topically, eucalyptus oil is generally safe. Reports of ACD caused by eucalyptus oil are scarce in the literature. Patch test concentrations ranging from 1% to 10% have been reported in the literature. It is possible that irritant reactions become more prevalent at higher concentrations. The use of a standardized test concentration would aid in the interpretation and reproducibility of the data.

As noted by Gyldenlove et al., the low rate of ACD caused by eucalyptus oil is surprising, given multiple reports of ACD caused by tea tree oil, which has constituents in common with eucalyptus oil (2). Rates of positive patch test reactions to tea tree oil of 0.5–5% have been described (14). There have also been small numbers of documented cases of ACD caused by cineole, terpinen-4-ol, and limonene, which are common to both oils (15). The allergenicity of tea tree oil increases greatly with oxidation, mainly through the creation of hydroperoxides that act as haptens in the skin (16). It may be that the much lower rate of ACD caused by eucalyptus oil is related to its high content of 1,8-cineole, which probably follows a different oxidation pathway from those monoterpenoids with different moieties or unsaturated double bonds.

With the increasing use of eucalyptus oil in hand sanitizers, including those that are home-made (17), the potentially severe risks posed by accidental ingestion, for example by children, should also be considered (18). Because these products may be readily available, we propose that safety measures be instituted, such as appropriate labelling, child-resistant packaging, consumer education, and non-removable dispensers in hospitals.

Conclusion

ACD caused by eucalyptus oil is rare but possibly underreported, and its frequency may be increasing as the use of plant oils becomes more popular (2). The use of eucalyptus oil is generally safe, provided that people adhere to recommended doses and delivery routes. It is important to patch test people who are likely to be exposed to eucalyptus, such as florists, gardeners and those using cleaning products, as well as the general patch test population. It would also be interesting to examine cross-reactions between eucalyptus and tea tree oil and other essential plant oils with shared constituents.

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