

The effectiveness of benzyl benzoate and some essential plant oils as laundry additives for killing house dust mites

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Both bedding and clothing may contain high populations of pyroglyphidae mites. High levels of exposure to mite allergens has been causally associated with increased asthma severity,¹ and reducing such exposure is advocated as an important component of asthma management. Washing clothing and bedding in warm water removes most accumulated allergen but has little effect on mite populations.² Effective long-term allergen control requires additional killing of mites. This only occurs at water temperatures higher than 55° C, a temperature not achieved in many domestic laundry systems nor encouraged by the common use of cold-water detergents. In addition, some fibers shrink or are damaged at these temperatures. There are no specifically acaricidal laundry products available, though we have previously shown that one containing eucalyptus oil reduced mite survival, whereas other products enhanced survival.² We have tested low concentrations of a common acaricide, benzyl benzoate and five essential oils for their ability to kill mites under conditions that simulate those occurring during warm-water laundering.

METHODS

The method used to test for acaricidal activity has been previously described in detail.² Briefly, groups of 50 live mites from culture were placed in mesh capsules,² in triplicate, and immersed in each acaricidal solution for 10, 20, or 30 minutes at 30° C. The acaricides were benzyl benzoate (Sigma Chemical Co., St. Louis, Mo.), citronella oil, eucalyptus oil, spearmint oil (Sunsprint, Byron Bay, Australia), tea tree oil (Thursday Plantation, Ballina, Australia), and wintergreen oil (Bronson and Jacobs, Sydney, Australia). All were mixed 4:1 with Tween 20 (Sigma Chemical Co.)

as dispersant and then tested at 0.1%, 0.5%, and 0.8% for benzyl benzoate and at 0.8% for the essential oils. Tween-only solutions (0.8%) were used as controls. After exposure, capsules were rinsed with water, drained, and then maintained in a humid atmosphere to aid recovery for 12 hours before the mites were classified as dead or live on the basis of mobility.

The approach to statistical analysis has been previously described.² Briefly, chi square analysis was used to examine the homogeneity of the control data and the differences in the proportion of mites killed by each solution over different time periods. Tukey's test for multiple comparisons was used for more detailed analysis.

RESULTS

With benzyl benzoate, all the mites were killed by the 0.8% solution, and most were killed by the 0.5% solution (not significantly different from 0.8%, $p \leq 0.05$). The effectiveness of benzyl benzoate dropped off sharply at the lower dilutions for shorter periods (Fig. 1).

All of the oils killed more than 80% of mites after 30 minutes, and with the exception of citronella, they killed more than 60% of mites after 10 minutes (Fig. 1). The effectiveness of all oils decreased with shorter exposure times. Only citronella oil and tea tree oil (both used for 30 minutes) were as effective as 0.5% benzyl benzoate ($p > 0.5$, $p > 0.05$, respectively). For shorter exposure times, tea tree oil was the most effective, killing 79% of mites in 10 minutes. Less than 10% of mites were killed by the control solution.

DISCUSSION

This study demonstrates that low concentrations of either benzyl benzoate or some essential oils in warm laundry solutions will kill most, if not all, mites. The required volume of acaricide solution is practical for a laundry additive because the volume required is equivalent to 250 ml per 30 L washing machine. The use of such additives to kill mites would overcome the need to wash at temperatures higher than 55° C, which may not be available or feasible.

From the Department of Medicine, University of Sydney.
Supported by the Asthma Foundation of New South Wales,
Wool Research and Development Corporation, and the National Health and Medical Research Council of Australia.
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J ALLERGY CLIN IMMUNOL 1993;92:771-2
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0091-6749/93 \$1.00 + .10 1/54/48996

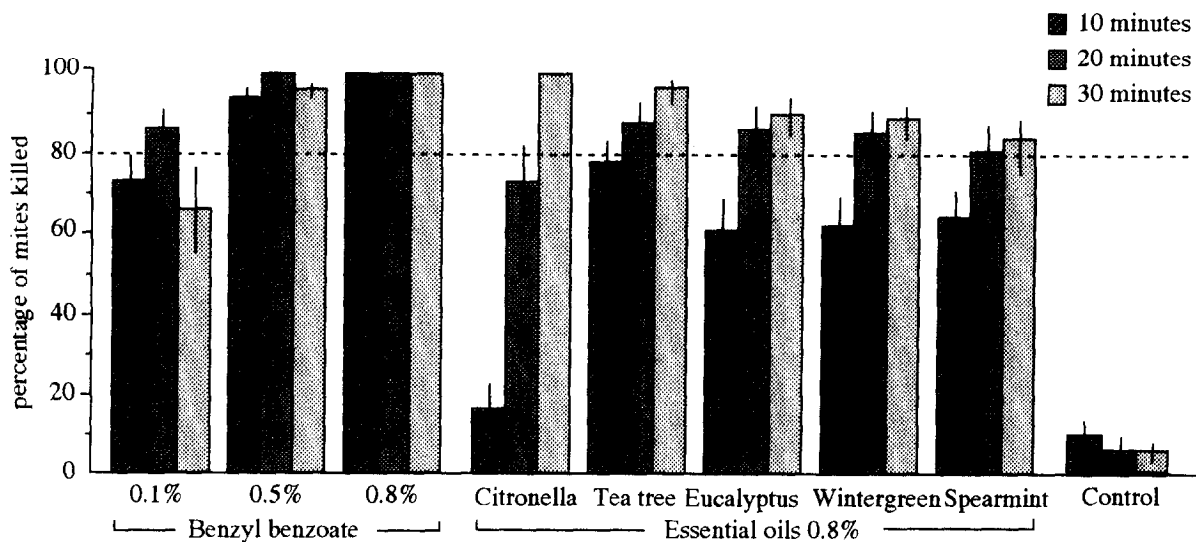


FIG. 1. Percentage of mites killed ($\pm 95\%$ confidence interval) at 30°C by 0.1%, 0.5%, and 0.8% solutions of benzyl benzoate and 0.8% solutions of citronella oil, tea tree oil, eucalyptus oil, wintergreen oil, and spearmint oil and control 0.8% Tween 20 solution. The dotted line shows 80% killing achieved by all oils.

The most potent activity was demonstrated by benzyl benzoate. However, the public perception and acceptance of washing products containing natural essential oils may be more positive. The most promising oil tested was tea tree oil, which best maintained potency over a range of washing times.

The mechanism of killing is not known, though tea tree oil is traditionally used in Australia as a topical fungicide and antiseptic. The vapor of some of these essential oils,³ and others, particularly Japanese cedar and Eastern red cypress oils (M. Takaoka, personal communication with A. Woolcock, 1992) has been shown to kill pyroglyphid mites. The further screening of these and other essential oils in solution is required. Criteria for choosing the most suitable oil would include its acaricidal activity with time and temperature, volatility, the acceptability of fragrance, and any adverse effects on fabrics. Essential oils may also

be particularly suitable for inclusion in carpet washing solutions, which are not fully recovered and in which the residual acaricide may aid in maintaining mite control. These studies suggest that dilute solutions of essential oils are potentially an effective, acceptable, and inexpensive method of controlling house dust mites.

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