

# THE FUNCTION OF A REPELLENT IN HEAD LOUSE CONTROL

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**This article explains how head lice repellents work, and how they might be of use in head lice control**

THE purpose of an insect repellent is to keep insects away. The best known chemicals used for this purpose are directed against mosquitoes and other biting flies. They mostly operate at a distance to confuse the insects' direction finding mechanisms, and close up they act as sensory blockers.<sup>1</sup> Such chemicals are, of necessity, volatile and consequently remain on the user for a limited period of time.

Until now, no attempt has been made to develop a repellent formulation for use against head lice and, since the 1939-45 war, control of head lice has, for the most part, been based on treatment with synthetic insecticide preparations once lice are found. Some repellent activity has been reported for lavender oil used against clothing lice and for a preparation called Staway which was originally used against mosquitoes but found to have some effect used against crab lice.<sup>2</sup> Whether repellency was not investigated for head lice because of entrenched attitudes or because other known repellent materials were ineffectual is unclear. In any case, few repellent chemicals and plant extracts, in the form of essential oils believed to protect the plants for insect attack, appear to have much effect on human lice (I. Burgess, unpublished results).

Changes in the approach to head lice eradication and more efficient use of insecticides have had the result that a head louse repellent can now play a part in the control of the infection because the total numbers of head lice on each case are considerably reduced. The fewer the lice on an infected head the smaller the possibility that any lice will make a transfer onto any other head placed in contact. If that other head has been treated with repellent the risk of transfer of lice is further reduced. Such a situation did not apply just a decade ago because at that time attitudes to head lice were different, infections were not generally detected at such an early stage as now and diagnosis of lice was still largely performed by school nurses and often only at school head inspections held termly or even less frequently.

When routine school head inspections were performed in every district the approach was largely that of a "fire fighting" service in removing obvious cases of infection and identifying pockets of transmission. No attempt was made at instituting any form of preventive measures nor were there any that were generally acknowledged. Such a



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routine of inspections of children failed to address the problem in two ways. Primarily it ignored the fact that head lice are a community problem and by inspecting only a small proportion of the population it was doomed to fail. What the 1944 Education Act clearly intended as a measure to improve the health and well-being of children actually rebounded upon itself because no direct provision was made for the community.<sup>4</sup> The second failure arose because the diagnosis of head lice and their eradication became the province of a small group of professionals and the responsibility and skills involved were inadvertently denied to the parents of the children and the community at large for more than a generation.<sup>3,4</sup>

In recent years, strenuous attempts have been made to redress the balance in most forward looking health authorities. Not only is the role of the school nurse changed to that of educator and adviser on lice, there is some attempt at control of head lice by non-insecticidal means. Such measures at their most basic include contact tracing, in order to reduce reinfection, and regular checking of hair within the family group, using detection combs, so that if lice should be

caught by someone they can be restricted to that individual. Some authorities have actually tried to institute programmes of grooming in schools with the aim of eliminating lice either by combing them out or in the hope that they are damaged by the teeth of the comb.<sup>5,6</sup> These have met with little success in epidemiological terms largely because the basic methodology was flawed. Nevertheless, the underlying concept that improved grooming will lead to fewer lice is probably correct even if it simply results in more attention being paid to hair care that ultimately leads to improved diagnosis.

The worst problem currently faced by everyone involved in the control and eradication of lice is the abuse of pesticide formulations by the public in which products originally intended for therapeutic use are used prophylactically. This mostly involves the use of shampoo products and the majority of purchases of these items are probably intended for routine, and in many cases weekly, use in

the hope of killing any lice that chance to transfer before they have time to establish. An even more nefarious practice is to sprinkle a few drops of an alcoholic lotion onto the hair in the hope that they will give a few days' residual insecticide protection. Both approaches are to be condemned because they do not fulfil the aim of the products' use and could enhance the risk of insecticide resistance in lice. In the case of shampoos the risk is that the concentrations of insecticides used are too low, often even to kill lice and certainly to kill eggs, and the contact times are too short. In the case of small quantities of lotion only a limited part of the hair will be treated and generally no barrier is presented to lice because little or no residual insecticide is offered.

Residual insecticide activity is an unpredictable phenomenon at best. Early studies of malathion efficacy and of carbaryl suggested a residual effect up to several weeks.<sup>7,8</sup> While it is true that some people's hair will bind malathion, carbaryl is never bound to hair and is removed the next time the hair is washed. The apparent residual effect seen in early studies was more likely due to an effective treatment followed by a lack of exposure to reinfection, which was relatively novel at the time because previous treatments were so ineffective. In recent years, a real residual activity has been identified with permethrin products that

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## THE ARENA TEST

THE Arena test is a simple repeatable test designed to compare repellent effects of different materials. It can be used for any chemical that is soluble in an aqueous or organic evaporating base.

A single 55mm disc of Whatman No 1 filter paper is used for each arena. A pencil line is drawn across the centre of the paper and 50µL of the test solution applied to cover the surface of one half, such that the solvent spread is no further than the pencil line. Each treated disc is dried for 30 minutes in a fume cabinet set for maximum air flow.

For the test, each disc is placed in a 90mm glass Petri dish and 10 young adult and third instar lice are dropped onto the untreated half. The closed dishes are then incubated at 30°C and 50 per cent relative humidity and the distribution of lice noted every two minutes during a total test period of 10 minutes.

In order to avoid competing effects from different materials under test, the dishes are arranged on trays using Graeco-Latin squares during the test incubation.

may persist several weeks.<sup>9</sup> Where a residual insecticide layer occurs it is always at risk of removal by other hair treatments or environmental factors and will in any case gradually wear off. As the residual insecticide is lost a point will be reached at which it is no longer at a sufficient level to be toxic to any insects exposed to it.<sup>10</sup> From such insects resistant populations could be selected if they have the enzymic mechanisms to degrade the pesticide.

Rappell (Charwell Pharmaceuticals Ltd) is the first head louse repellent formulation available through community pharmacies in Britain. It is based on the fragrance and flavouring agent piperonal (1,3-benzodioxole-5-carboxaldehyde). When formulated in an aqueous base, with proprietary solubilising agents and 30 per cent alcohol, piperonal used in the laboratory consistently shows 90 per cent or more inhibition of incursion of lice moving onto treated hair or filter paper.<sup>11</sup> A typical set of results, comparing the effects of filter papers treated on one half with Rappell and a control batch treated on one half with the formulation base (the Arena test, see Panel above) is shown in Table 1.

Piperonal does not work in the same way as a flying insect repellent. Since lice only crawl from one host to another they have no need to detect a new host at a distance because they are already safely on one. The stimulus to move, which takes lice onto a new host, is disturbance of the hair as heads come together. Many of the movements are entirely random and most will not bring them into contact with a new head. However, some lice may pass from one head to another and it is at this point that piperonal has an effect. We do not yet know how it

**Table 1: Comparison of the inhibition effects of Rappell and the formulation base without piperonal (control). Ten lice were used in each replicate**

Treatment	Replicate	Number of lice on treated surface at					Total number of incursions
		2 min	4 min	6 min	8 min	10 min	
Rappell	1	0	0	0	0	0	3
	2	0	1	0	1	0	
	3	0	1	0	0	0	
Control	1	4	1	1	5	7	45
	2	1	2	4	2	5	
	3	2	4	3	3	1	

$$\text{Inhibition} = 100 - \left( \frac{\text{Number of test incursions} \times 100}{\text{Number of control incursions}} \right) \%$$

$$= 100 - \left( \frac{3 \times 100}{45 \times 100} \right) \%$$

$$= 93.3\%$$

works but it clearly has a sensory irritant effect and may be picked up through the antennae, the claws or both. In this sense also piperonal is completely different from mosquito repellents.

The practical use of a head louse repellent will be two-fold:

1. Most authorities are now encouraging families to perform contact tracing of each head louse infection. A repellent can be used in the period following treatment until the source of the infection, and the contacts to whom lice have been passed are identified. Use in this circumstance will help prevent inadvertent reinfections before all cases are found and the lice eradicated.
2. The abuse of insecticide formulations by consumers who are seeking a prophylactic effect appears to be widespread. Some of these apply treatment regardless of whether they are likely to be exposed to lice and do so out of a form of entomophobic paranoia. In most cases insecticidal shampoos are used, regularly or when it is felt that the risk is greatest, and mostly on children. The use of pesticides in such a manner is contrary to their intended use and, since most formulations contain some elements which may prove irritant or otherwise unpleasant, it is a dangerous practice both in terms of safety and with regard to the possible risk of some lice becoming resistant to the treatments. The introduction of a repellent now leaves no excuse for such abuse of pesticides. At the same time it fills a requirement of the more responsible members of the public who have recognised the need for some form of prophylactic for lice but who have declined to attempt this by misuse of insecticide products.

Repellents do not interfere with district or regional policies on the selection or rotation of insecticides because they are a separate entity. A repellent must only be used by people who do not have lice, whereas the insecticides must only be used by people who do have lice. Consequently, their uses are mutually exclusive although complementary, as already mentioned. If a repellent works effectively there is no reason to believe that lice will eventually become tolerant of it in much the same way as mosquitoes have not become insensitive to repellents used against them. The only

worry is that some members of the public will become complacent and not check their families regularly to ensure the repellent is working adequately. Such people are probably already cavalier in their approach to the risk of louse infection but there is always the possibility that once lice are trapped behind a layer of repellent treated hair they may be as unwilling to cross back out through it as they are to pass to the head in the first place.

No insect repellent is foolproof but proper use of louse repellents offers the prospect of being able to reduce the transmission of head lice more effectively than other methods so that even the relatively low numbers of both lice and cases of infection currently found will be reduced. In turn the level of head louse hysteria should be reduced so that the infection can be brought to its rightful place as a relatively minor community disease and the specific therapeutic formulations used only for its eradication.

**ACKNOWLEDGMENT** This work was sponsored by Charwell Pharmaceuticals Ltd.

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