9. Control of dust mites and allergen avoidance

I took a glass tube somewhat larger than a swan’s quill, one end of which I stopped with cork, and after putting into the glass tube some hundreds of mites, I cut a small piece of nutmeg of a size that would fit into it; and I perceived that the mites next to the nutmeg soon died. I then put another piece at the other extremity of the tube where there were many live mites, which also died in a short time.

Antoni van Leeuwenhoek, 1695,
Missive 88, to Antonius Heinsius.
(see Ford, 1985, p. 83.)

9.1 Introduction

In Leeuwenhoek’s account of probably the first documented experiment on acaricides, he describes how he discovered the toxic effect was due to a volatile substance evaporating from the nut (Figure 9.1). Incidentally, nutmeg and nutmeg oil have been used traditionally as an insecticide (Norman, 1990; Y. Huang et al., 1997). Nutmeg is only one of several plant-associated acaricides that have been examined for their ability to control domestic mites. Some, like caffeine (Russell et al., 1991), nicotine, phenyl salicylate and azadirachtin (derived from the neem tree, Azadirachta indica), have got no further than laboratory or field testing. Others, such as pyrethroids (synthetic analogues of compounds from the pyrethrum daisy) and benzyl benzoate (from Peru balsam) have been deployed in clinical trials. Tannic acid has been used as an allergen denaturant, and tea-tree oil and eucalyptus oil have been used as laundry additives (McDonald and Tovey, 1993; Tovey et al., 2001).

Initial studies on reduction in allergen exposure focused on the removal of patients to low-allergen environments, either in hospitals (Storm van Leeuwen et al., 1927; Platts-Mills et al., 1982), or at high altitude locations (Storm van Leeuwen et al., 1924; Storm van Leeuwen, 1927; Vervloet et al., 1979, 1982) where there were few mites (Voorhorst et al., 1969). More recent high-altitude trials were reviewed by Tovey (1997). Generally patients showed marked improvement of the clinical symptoms of asthma. For example, Platts-Mills et al. (1982) showed dramatic reduction in bronchial hyperreactivity to histamine (PC\textsubscript{20}), indicating the underlying importance of mite allergens in airway constriction and spasm. Bronchial hyperreactivity is a defining feature of allergic asthma. It follows that reduction in hyperreactivity is a key outcome of interventions designed to reduce allergen exposure.

Once it appeared that low-allergen environments were of clinical benefit, a new wave of trials focused on reducing patients’ exposure within their homes. Improvement in symptoms of asthma due to domestic
cleaning and removal of mites was first reported anecdotally by Dekker (1928), but the first trials began in the 1970s, mostly short term, with children, and using mattress covers, cleaning and washing of bedding as the main interventions (Sarsfield et al., 1974; Burr, et al., 1976, 1980a; Warner, 1978). These trials showed marginal benefits or were unsuccessful. Only that by Burr et al. (1980a) included the monitoring of mite populations and it found no reduction in symptoms. In the 1970s, most people would have had no knowledge of the role of mite allergens in asthma and access to little information, and the news that their homes were infested with mites which were making their children sick may have reduced their compliance with the interventions. Indeed, Sarsfield et al. (1974) observed that ‘great tact’ was needed to put across the concept of mite allergy: ‘the mother must not be allowed to think that dust is associated with uncleanliness or that she has failed in her role as housewife and mother.’ Contrast this with the contemporary perspective, where mite infestation carries no stigma, and most patients view allergen avoidance as a logical procedure for a disease caused by allergen exposure.

By the 1990s, allergen avoidance was being considered potentially useful to prevent the development of asthma in infants at high risk of becoming sensitised (Arshad et al., 1992; Hide, 1996). Reduction of allergen exposure prior to development of allergies is referred to as primary avoidance, whereas secondary avoidance refers to reduction in exposure after allergic disease has developed. Tertiary interventions refer to the removal of patients to low allergen environments.

The results of clinical trials have been mixed, but the notion that allergen avoidance could be used for preventing and managing asthma prompted a burgeoning industry in anti-mite products from the early 1990s. Products were sold direct to the public and used without medical supervision or a diagnosis of mite-induced allergy. Some products have been subject to field and clinical trials, but for many their efficacy remains undemonstrated. Several clinical trials used a particular product as the sole or primary treatment (so called ‘mono-faceted’ trials), often with disappointing results. Others (‘multifaceted’ trials) used combinations of control methods deployed more rigorously, and with a tendency for greater success.

Methods for dust mite control and allergen removal and isolation have been reviewed exhaustively (de Saint Georges-Gridelet et al., 1988; Thompson and Stewart, 1989; Colloff, 1989b, 1990; Colloff et al., 1992b; Tovey, 1992; van Asperen, 1993; Tovey, 1997; Tovey and Marks, 1999; Platts-Mills et al., 2000). In the first part of this chapter I detail the various methods that are available for killing dust mites and removing allergens, including the mode of action and investigations on acaricidal or allergen-reducing efficacy. I focus only on those methods that have been tested in field and clinical trials, are generally accessible and reasonably widely used. This excludes the many products and procedures that enjoyed a brief flurry of interest but are either no longer commercially available or were the subject of only one or two studies. I avoid the use of trade names where possible, but where they are used for the sake of clarity, no endorsement of the product should be implied. In the second part of the chapter I examine clinical trials and the clinical efficacy of killing mites and avoiding their allergens. Most clinical trials have been done on groups of patients with allergic asthma, and far fewer with patients with rhinitis or eczema.

Killing dust mites is not the same as allergen avoidance, although they are often assumed to be synonymous. One could kill every mite in a home, but unless the allergens are removed, the allergenic load and exposure risk remains the same. If one removes allergens without killing mites, the allergen load may decrease temporarily, but will then build up again as mites grow, reproduce and defecate. Substantial reductions in mite population density and allergen concentrations are likely to be necessary if a lasting clinical benefit is to be achieved. This means a combination of acaricidal methods (be they chemical or physical) and thorough vacuuming and cleaning (see Table 9.1).