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Allergens originate from a diverse range of plants, higher animals, and insects. They include proteins and glycoproteins, the majority of which have molecular weights in the range 10–60 kDa. The identification and characterization of individual allergens follows from the use of aqueous extracts of natural source materials for diagnosis by skin testing, provocation testing, and *in vitro* methods. Electrophoretic separation techniques, combined with immunoblotting with sera from sensitized patients, yield basic biochemical information and an indication of the number and nature of allergens associated with a particular source material. Cloning from cDNA libraries then opens the door to detailed information on protein structure that is essential for a better understanding of the mechanisms of sensitization.

Allergenic activity is dependent on the ability of proteins to interact with specific IgE antibodies bound to Fc $\epsilon$ R1 receptors on mast cells and basophils, and thereby trigger release of inflammatory mediators and cytokines that induce and perpetuate the allergic state. The majority of IgE-binding epitopes are dependent on the three-dimensional structure of the allergens. This has been clearly demonstrated by genetic engineering techniques to produce variant forms of allergens, such as Timothy grass pollen Phl p 5 (1) and birch pollen Bet v 1 (2), which have greatly reduced IgE-binding activity. On the other hand, T-cell epitopes are encoded in specific sequences of amino acids in the primary structure and can be identified by dodecapeptides based on that structure. The cross-reactivity between related allergens can be explained in terms of structural similarities at the epitope level, but, more importantly, this feature provides a basis for designing hypoallergenic variants that hold promise for improved allergen-specific therapeutic vaccination.

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While genetic and environmental factors appear to contribute to an individual's susceptibility to allergen sensitization, various lines of evidence suggest that intrinsic biochemical properties of allergenic proteins may be of importance. Allergens can be grouped into several broad categories such as hydrolytic enzymes, which comprise the largest and most frequently recognized group, nonhydrolytic enzymes, enzyme inhibitors, specific ligand-binding proteins including calcium-binding proteins and lipocalins, regulatory proteins, and a group with as yet unrecognized biological activities (3). These various activities may influence the handling of the molecules at mucosal surfaces with the result that they can contribute to the orientation of their immunologic processing in favour of an allergic response. The allergen of the house-dust mite, Der p 1, which is a cysteine protease, is probably the most studied allergen in this regard. Der p 1 has been shown to be able to cleave

$\alpha$ 1-antitrypsin, an anti-serine protease with a protective role in the respiratory tract, and to cause disruption of the epithelial barrier, actions which could facilitate access to cells of the immune system. Furthermore, Der p 1 has the potential to be able to induce a Th<sub>2</sub> environment conducive to an allergic state through IgE-independent release of IL-4 and histamine from mast cells, and also to compromise lymphocyte activities by cleavage of surface molecules such as CD23 and CD25 from B and T cells, respectively (4).

Various allergens have been shown to have similarities to human counterparts. These include the lipocalins, a group of proteins involved in the transportation of fat-soluble vitamins, pheromones, odorants, plant profilins, calcium-binding proteins, and mould enzymes. In these cases, it has been suggested that their allergenic activity may arise as a consequence of an inappropriate T-cell recognition between self and nonself.

## References

1. Schramm G, Kahlert H, Suck R, et al. "Allergen engineering": variants of the timothy grass pollen allergen Phl p 5b with reduced IgE-binding capacity but conserved T cell reactivity. *J Immunol* 1999;162:2406–2414.
2. Vrtala S, Hirtenlehner K, Vangelista L, et al. Conversion of the major birch pollen allergen Bet v 1 into two nonanaphylactic T cell epitope-containing fragments: candidates for a novel form of specific immunotherapy. *J Exp Med* 1997;99:1673–1681.
3. Stewart GA, Thompson PJ. The biochemistry of common aeroallergens. *Clin Exp Allergy* 1996;26:1020–1044.
4. Schulz O, Sewell HF, Shakib F. The interaction between the dust mite antigen Der p 1 and cell-signalling molecules in amplifying allergic disease. *Clin Exp Allergy* 1999;29:439–444.