

Special report

Allergen nomenclature*

Te Piao King, Hoffman D, Lowenstein H, Marsh DG, Platts-Mills TAE,
Thomas W. Allergen nomenclature.
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T. P. King, D. Hoffman, H. Lowenstein,
D. G. Marsh, T. A. E. Platts-Mills,
W. Thomas

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A. Introduction

Rapid advances have been made in the past few years in allergen characterization and sequence determination by chemical and molecular biological approaches. This is indicated by the list of allergens with known partial or complete amino acid sequences in Table 1. A number of other important allergens are known in addition to those in Table 1 but their sequences are as yet not known. A useful source for known allergens is the Allergen Database (ALBE) in which are compiled their known biochemical and immunological properties together with their sequence data if known (1).

To take into account these advances, a revision of the current allergen nomenclature system (2) is given below. As in the current nomenclature system, the proposed revisions are for allergens which induce IgE-mediated (atopic) allergy in humans. In addition to the expected thorough immunochemical characterization of any newly discovered allergen, investigators are urged to obtain partial, or preferably complete, sequence data before using the official nomenclature system. Also it is expected that investigators would screen a reasonable population size so as to establish the frequency of response in patients to the newly discovered allergens.**

Investigators frequently refer to allergens as major or minor ones. The generally accepted meaning of this terminology is that an allergen is designated as either major or minor depending on whether greater or less than 50% of patients tested have the corresponding allergen-specific IgEs (cf. 3-5).

The revised nomenclature for allergens is given

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** Investigators are invited to consult our committee members for assigning an allergen number before publication so as to avoid duplication.

below together with the proposed nomenclatures for (a) allergen genes, mRNAs and cDNAs and (b) recombinant and synthetic peptides of allergenic interest.

B. Revised allergen nomenclature

1. Allergens

Allergens are designated according to the accepted taxonomic name of their source as follows: the first three letters of the genus, space, the first letter of the species, space, and an Arabic number. The numbers are assigned to the allergens in the order of their identification, and the same number is generally used to designate homologous allergens of related species. As two examples, Lol p 1 refers to the first pollen allergen identified from *Lolium perenne*, ryegrass, and Cyn d 1 refers to the homologous pollen allergen from *Cynodon dactylon*, Bermuda grass.

In some instances, the above system of the first 3 letters of a genus and the first letter of a species has to be modified to include an additional letter for designation of the exact genus or species. For example, 4 of the many vespids which can cause insect allergy are *Vespula vulgaris*, *Vespula vidua*, *Vespula consobrina* and *Vespa crabro*. The homologous major venom allergens, antigen 5s, from *Vespula vulgaris* and *Vespula vidua* are both designated as Ves v 5 in the existing nomenclature, and those from *Vespula consobrina* and *Vespa crabro* are designated as Ves c 5. To avoid these ambiguities, antigen 5s from *Vespula vulgaris* and *Vespula vidua* will be designated as Ves v 5 and Ves vi 5 respectively, and those from *Vespula consobrina* and *Vespa crabro* as Ves c 5 and Vesp c 5. In the examples given, the modified nomenclature is used for the allergens from *Vespula vidua* and *Vespa crabro*, as the allergens from *Vespula vulgaris* were characterized prior to those for *Vespula vidua* and *Vespa crabro*.

Another example is for allergens from the domestic dog (*Canis domesticus*) and the mold *Candida albicans*. To avoid ambiguity, the modified system is used to designate Can d and Cand a allergens from these two sources respectively.

In the current nomenclature system (2) the letters are italicized and the numerals are Roman numerals. In the revised system, only letters of normal type and Arabic numbers are used. The proposed changes conform to the accepted nomenclature used in bacterial genetics (6) and the HLA system (7) in that italicized and normal characters are used to represent genotypes and phenotypes respectively.

2. Allergens and isoallergens

An allergen from a single species may consist of several closely similar molecules. These similar molecules are designated as isoallergens when they share the following common biochemical properties: a. similar molecular size; b. identical biological function, if known, e.g. enzymatic action; and c. 67% identity of amino acid sequences.

It is recognized that the recommended 67% sequence identity for 2 allergens to be assigned to the same group is only a guide. There are likely to be borderline cases. As an example, the ragweed allergens Amb a 1 and 2 share 65% amino acid sequence identity (8). These allergens were assigned to different groups because of their different immunochemical properties before their sequences were known.

Allergens from different species of the same or different genus which share the above-mentioned common biochemical properties are considered to belong to the same group and the sequence identity requirement can be <67% as is the case for allergens of the same species. For example, Amb a 5 and Amb t 5 from short and giant ragweed pollens have about 45% sequence identity (9), and also have similar tertiary structures (10, 11). Another example is the minor pollen allergens Amb a 10, Poa p 10 and Lol p 10 from ragweed (12), Kentucky bluegrass (13) and ryegrass (14). Although their sequences are not known, they are assigned to the same allergen group as they clearly have the same biological function of cytochrome c.

3. Isoallergens and variants

cDNA cloning of allergens often shows nucleotide mutations which are either silent or which can lead to single or multiple amino acid substitutions. In the revised system, members of an allergen group which have ≥67% amino acid sequence identity are designated as isoallergens. Each isoallergen may have multiple forms of closely similar sequences, which are designated as variants.

Isoallergens and their variants belonging to the

same allergen group are designated by suffixes of a period followed by four Arabic numerals. The first two numerals 01 to 99 refer to a particular isoallergen, and the two subsequent numerals 01 to 99 refer to a particular variant of a particular isoallergen designated by the preceding two numerals. In cases where there is only one known isoallergen but there are several variants, the system of a suffix of 4 numerals will still apply. These numerals will be chosen in the order of the identification of allergens and/or their cDNAs irrespective of the physicochemical properties of the allergens. In cases of silent mutations, there can be more than one suffix of 4 numerals designating the same allergen and in that case the suffix with the lowest number will be used to designate the allergen of interest.

The addition of suffixes of 4 numerals to designate isoallergens and their variants will permit their unambiguous designation. In many cases it is unnecessary to specify the isoallergen or variant and the corresponding suffixes may be deleted; e.g. Bet v 1 represents any Bet v 1 allergen and Bet v 1.0101 represents variant number 1 of isoallergen Bet v 1. Two other examples of this nomenclature system are given below.

On cDNA cloning, Amb a 1 showed multiple polymorphic forms which differ from each other by 12–24% in their sequences (8). Four such forms of Amb a 1 are known and they are designated as Amb a 1.01, 1.02, 1.03 and 1.04. Each isoallergen of the Amb a 1 group is found to have 1 to 3 variants with 97% of sequence identity. These variants of the Amb a 1.01 group will be designated as Amb a 1.0101, 1.0102, etc.

In contrast to Amb a 1, only two forms of Amb a 11 were found on cDNA cloning. These forms differ in two polymorphic sites and they have >99% amino acid sequence identity. They are designated as Amb a 2.0101 and 2.0102.

C. Nomenclature for allergen genes, mRNAs and cDNAs

At present the genomic structures of allergens are known in at least two cases; cat allergen Fel d 1 and mouse urinary allergen Mus m 1. Knowledge of the genomic structure can provide an understanding of how the different polymorphic forms are generated by differential splicing and/or exon usage. By adopting the revised nomenclature for allergens, we can reserve the italicized characters to designate an allergen gene. Normal characters are used for designation of mRNAs and cDNAs.

For example, Fel d 1 is a protein consisting of two polypeptide chains (15) which are encoded by two separate genes (16). The two allergen genes for chains 1 and 2 of Fel d 1 will be represented by *Fel*

d 1A and *Fel d 1B* respectively. Allelic forms of mRNAs and cDNAs of the *Fel d 1A* gene are designated as mRNA or cDNA *Fel d 1A.0101* where the numerals are to correspond to those of the polymorphic allergens.

D. Nomenclature for recombinant and synthetic peptides of allergenic interest

There is interest in the possible use of fragments of allergens as reagents to modulate allergen-specific immune responses. Such fragments may be prepared by recombinant technology or by chemical synthesis. Therefore it is useful to establish a generally accepted nomenclature for such peptides of allergenic interest.

The nomenclature for recombinant and synthetic peptides of allergenic interest is to be based on the nomenclature for naturally occurring allergens since it is well accepted by the scientific and the clinical communities. An allergen which is prepared by recombinant (r) or chemical synthetic (s) means is to be differentiated from a natural (n) allergen by the addition of the prefix r or s followed by a suffix of the amino acid residue positions which are given in parenthesis. For example, a recombinant hornet venom allergen Dol m 5.0201 which contains the entire sequence of 204 residues will be designated as rDol m 5.0201, and a recombinant or synthetic peptide of residue 151–165 of Dol m 5.0201 will be designated as r or sDol m 5.0201 (151–165) respectively.

Natural allergens may contain post-translational modifications as many proteins do. These modifications include glycosylation, acylation, methylation, etc. Recombinant or synthetic allergen, designated by the prefix r or s, is taken to indicate that it does not contain the post-translational modification of the natural allergen. If the recombinant or synthetic allergen does contain the exact same modification as that of the natural allergen, it will be designated by a prefix of rn or sn. For example, the honeybee venom allergen phospholipase A₂, Api m 1, is a glycoprotein with an oligosaccharide attached at the asparagine residue number 13 (17, 18). A synthetic peptide of residues 1–20 of Api m 1 without the oligosaccharide at residue 13 will be designated as sApi m 1

(1–20), and a synthetic peptide of residues 1–20 with the exact same oligosaccharide of the natural allergen will be designated as snApi m 1 (1–20).

For recombinant or synthetic fragments which are derivatives of sequences contained within the native allergen structure, an additional suffix enclosed in square brackets will be used to indicate that the peptide referred to is an analog. Substitutions or modifications of amino acid residues are given with the standard one-letter code and superscript numbers indicate the residue positions at which modifications occur. The one-letter codes for L-amino acids are given in upper-case letters and those for D-amino acids are in lower-case letters. The modifications, which can be substitution, insertion or deletion, are specified in parenthesis within the brackets. Obviously when there are many changes, it will not be practical to follow this nomenclature but to give the fully modified sequences. Examples of these analogs of sDol m 5.0201 (151–165) are given below:

Unmodified: sDol m 5.0201 (151–165)

Substitution: sDol m 5.0201 (151–165) [K¹⁵³]

- L-lysine residue at position 153 of sDol m 5.0201 (151–165) is substituted with D-lysine
- Insertion: sDol m 5.0201 (151–165) [+K¹⁵³]
- one residue of L-lysine is inserted between positions 153–154
- Deletion: sDol m 5.0201 (151–165) [–K¹⁵³]
- L-lysine residue at position 153 is deleted
- N-terminal modification: sDol m 5.0201 (151–165) [N-Ac]
- N-terminal amino group is acetylated
- C-terminal modification: sDol m 5.0201 (151–165) [C-NH₂]
- C-terminal carboxyl group is in the form of carboxamide

The nomenclature proposed above is very similar to that used for synthetic peptides representative of immunoglobulin sequences (19).

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Table 1 Some allergens with known sequences

Allergen source	Allergens: systematic and original names	MW (kDa)	Sequence data	References ¹
A. Weed pollens				
<i>Asterales</i>				
<i>Ambrosia artemisiifolia</i> (short ragweed)	Amb a 1: antigen E	38	C	8, 20
	Amb a 2: antigen K	38	C	8, 21
	Amb a 3: Ra3	11	C	22
	Amb a 5: Ra5	5	C	11, 23
	Amb a 6: Ra6	10	C	24, 25
	Amb a 7: Ra7	12	P	26
	Amb a?	11	C	27
<i>Ambrosia trifida</i> (giant ragweed)	Amb t 5: Ra5G	4.4	C	9, 10, 28
<i>Artemisia vulgaris</i> (mugwort)	Art v 2	35	P	29
B. Grass pollens²				
<i>Poales</i>				
<i>Cynodon dactylon</i> (Bermuda grass)	Cyn d 1	32	C	30, 31
<i>Dactylis glomerata</i> (orchard grass)	Dac g 1: AgDg1	32	P	32
	Dac g 2	11	C	33
	Dac g 5	31	P	34
<i>Lolium perenne</i> (ryegrass)	Lol p 1: group I	27	C	35, 36
	Lol p 2: group II	11	C	37
	Lol p 3: group III	11	C	38
	Lol p 5	31	P	34
	Lol p 9: Lol p lb	31, 35	C	39
<i>Phleum pratense</i> (timothy)	Phl p 1	27	C	40, 41
	Phl p 5: Ag25	32	C	42, 43, 44, 45
<i>Poa pratensis</i> (Kentucky bluegrass)	Poa p 1: group I	33	P	46
	Poa p 5	31	P	34
	Poa p 9	32, 34	C	47
<i>Sorghum halepense</i> (Johnson grass)	Sor h 1		C	48
C. Tree pollens				
<i>Fagales</i>				
<i>Alnus glutinosa</i> (alder)	Aln g 1	17	C	49
<i>Betula verrucosa</i> (birch)	Bet v 1	17	C	50
	Bet v 2: profilin	15	C	51
<i>Corylus avellana</i> (hazel)	Cor a 1	17	C	53
<i>Quercus alba</i> (white oak)	Que a 1	17	P	54
<i>Pinales</i>				
<i>Cryptomeria japonica</i> (sugi)	Cry j 1	41–45	C	55, 56
	Cry j 2		C	57, 58

Table 1. Continued.

Allergen source	Allergens; systematic and original names	MW (kDa)	Sequence data	References ¹
<i>Juniper sabinoides</i> (mountain cedar)	Jun s 1	50	C	58
<i>Juniper virginiana</i> (eastern red cedar)	Jun v 1	45–50	C	58
<i>Olea</i>				
<i>Olea europaea</i> (olive)	Ole e 1	16	C	59, 60
D. Mites				
<i>Dermatophagoides pteronyssinus</i> (mite)	Der p 1; antigen P ₁	25	C	61
	Der p 2	14	C	62
	Der p 3; trypsin	28/30	P	63
	Der p 4; amylase	60	P	64
	Der p 5	14	C	65
	Der p 6; chymotrypsin	25	P	66
	Der p 7	22–28	C	67
<i>Dermatophagoides microceras</i> (mite)	Der m 1	25	P	68
<i>Dermatophagoides farinae</i> (mite)	Der f 1	25	C	69
	Der f 2	14	C	70, 71
	Der f 3	30	P	72
<i>Lepidoglyphus destructor</i> (storage mite)	Lep d 1	15	P	73
E. Mammals				
<i>Canis domesticus</i> ³				
	Can d 1	25	C	74, 75
	Can d 2	27	C	74, 75
<i>Felis domesticus</i> (cat saliva)	Fel d 1; cat-1	38	C	15
<i>Mus musculus</i> (mouse urine)	Mus m 1; MUP	19	C	76, 77
<i>Rattus norvegicus</i> (rat urine)	Rat n 1	17	C	78, 79
F. Fungi				
<i>Aspergillus fumigatus</i>				
	Asp f 1	18	C	80
	Asp f 2	90	P	81
	Asp f 3	55	P	82
<i>Candida albicans</i>	Candi a 7	40	C	83
<i>Alternaria alternata</i>	Alt a 1	28	P	84–86
<i>Trichophyton tonsurans</i>	Tri t 1	30	P	87
G. Insects				
<i>Apis mellifera</i> (honeybee)				
	Api m 1; phospholipase A ₂	16	C	88
	Api m 2; hyaluronidase	44	C	89
	Api m 4; melittin	3	C	90

Table 1. Continued.

Allergen source	Allergens; systematic and original names	MW (kDa)	Sequence data	References ¹
<i>Bombus pennsylvanicus</i> (bumblebee)	Bom p 1; phospholipase	16	P	91
	Bom p 4; protease		P	91
<i>Blattella germanica</i> (cockroach)	Bla g 2	20	C	92
<i>Chronomus thummi thummi</i> (midge)	Chi t 1; hemoglobin	16	C	93
<i>Dolichovespula maculata</i> (white-face hornet)	Dol m 1; phospholipase A ₁	35	C	94
	Dol m 2; hyaluronidase	44	C	95
	Dol m 5; antigen 5	23	C	96, 97
<i>Dolichovespula arenaria</i> (yellow hornet)	Dol a 5; antigen 5	23	C	98
<i>Polistes annularis</i> (wasp)	Pol a 1; phospholipase A ₁	35	P	99
	Pol a 2; hyaluronidase	44	P	99
	Pol a 5; antigen 5	23	C	98
<i>Polistes exclamans</i> (wasp)	Pol e 1; phospholipase A ₁	34	P	101
	Pol e 5; antigen 5	23	C	98
<i>Polistes fuscatus</i> (wasp)	Pol f 5; antigen 5	23	C	100
<i>Polistes metricus</i> (wasp)	Pol m 5; antigen 5	23	P	100
<i>Vespula flavopilosa</i> (yellow jacket)	Ves f 5; antigen 5	23	C	100
<i>Vespula germanica</i> (yellow jacket)	Ves g 5; antigen 5	23	C	100
<i>Vespula maculifrons</i> (yellow jacket)	Ves m 1; phospholipase A ₁	33.5	C	102
	Ves m 2; hyaluronidase	44	P	103
	Ves m 5; antigen 5	23	C	98
<i>Vespula pennsylvanica</i> (yellow jacket)	Ves p 5; antigen 5	23	C	100
<i>Vespula squamosa</i> (yellow jacket)	Ves s 5; antigen 5	23	C	100
<i>Vespula vidua</i> (wasp)	Ves vi 5	23	C	100
<i>Vespula vulgaris</i> (yellow jacket)	Ves v 1; phospholipase A ₁	35	C	99
	Ves v 2; hyaluronidase	44	P	99
	Ves v 5; antigen 5	23	C	98
<i>Vespa crabo</i> (European hornet)	Vesp c 1; phospholipase	34	P	101
	Vesp c 5.0101; antigen 5	23	C	100
	Vesp c 5.0102; antigen 5	23	C	100
<i>Solenopsis invicta</i> (fire ant)	Sol i 2	13	C	104, 105
	Sol i 3	24	C	104
	Sol i 4	13	C	104
H. Foods				
<i>Gadus callarias</i> (cod)	Gad c 1; allergen M	12	C	106

Table 1. Continued.

Allergen source	Allergens; systematic and original names	MW (kDa)	Sequence data	References
<i>Gallus domesticus</i> (chicken)	Gal d 1; ovomucoid	28	C	107, 108
	Gal d 2; ovalbumin	44	C	107, 108
	Gal d 3; conalbumin (Ag22)	78	C	107, 108
	Gal d 4; lysozyme	14	C	107, 108
<i>Penaeus aztecus</i> (brown shrimp)	Pen a 1	36	P	109
	Pen a 2; tropomyosin	34	P	110
<i>Brassica juncea</i> (oriental mustard)	Bra j 1; 2S albumin	14	C	111
<i>Hordeum vulgare</i> (barley)	Hor v 1; BMAI-1	15	C	112
<i>Sinapis alba</i> (yellow mustard)	Sin a 1; 2S albumin	14	C	113
I. Others				
<i>Ascaris suum</i> (worm)	Asc s 1	10	P	114
<i>Hevea brasiliensis</i> (rubber)	Hev b 1; elongation factor	58	P	115

¹ References refer to those where partial (P) or complete (C) sequence data are available. The original references describing the initial characterization studies are not given because of limited space. Also we apologize to our colleagues whose allergen sequence data we may have overlooked for inclusion in this table.

² Sequence data for groups 5 and 9 allergens from several grass pollens indicate that they are highly homologous proteins. Comparison of complete sequence data of groups 5 and 9 allergens from a single grass species will clarify whether these two groups are the same protein.

³ *Canis domesticus* is also designated as *Canis familiaris*.

References

- MARSH, D.G., AND L.R. FREIDHOFF. 1992. ALBE, an allergen database. IUIS, Baltimore, MD, Edition 1.0.
- MARSH, D.G., L. GOODFRIEND, T. P. KING, H. LÖWENSTEIN, AND T. A. E. PLATTS-MILLS. 1986. Allergen nomenclature. Bull. WHO 64: 767-770.
- KING, T.P., P.S. NORMAN, AND J.T. CORNELL. 1964. Isolation and characterization of allergen from ragweed pollen. II. Biochemistry 3: 458-468.
- LÖWENSTEIN, H. 1980. Timothy pollen allergens. Allergy 35: 188-191.
- AUKRUST, L. 1980. Purification of allergens in Cladosporium herbarum. Allergy 35: 206-207.
- DEMEREK, M., E. A. ADELBERG, A. J. CLARK, AND P. E. HARTMAN. 1966. A proposal for a uniform nomenclature in bacterial genetics. Genetics 54: 61-75.
- BODMER, J. G., E. D. ALBERT, W. F. BODMER, B. DUPONT, H. A. ERLICH, B. MACH, S. G. E. MARSH, W. R. MAYR, P. PARHAM, T. SASUKI, G. M. TH. SCHREUDER, J. L. STROMINGER, A. SVEIGAARD, AND P. I. TERASAKI. 1991. Nomenclature for factors of the HLA system, 1990. Immunogenetics 33: 301-309.
- GRIFFITH, I.J., J. POLLOCK, D.G. KLAPPER, B.L. ROGERS, AND A.K. NAULT. 1991. Sequence polymorphism of Amb a I and Amb a II, the major allergens in Ambrosia artemisiifolia (short ragweed). Int. Arch. Allergy Appl. Immunol. 96: 296-304.
- ROEBBER, M., D. G. KLAPPER, L. GOODFRIEND, W. B. BIAS, S. H. HSU, AND D. G. MARSH. 1985. Immunochemical and genetic studies of Amb t V (Ra5G), an Ra5 homologue from giant ragweed pollen. J. Immunol. 134: 3062-3069.
- METZLER, W. J., K. VALENTINE, M. ROEBBER, M. FRIEDRICH, D. G. MARSH, AND L. MUELLER. 1992. Solution structures of ragweed allergen Amb t V. Biochemistry 31: 5117-5127.
- METZLER, W. J., K. VALENTINE, M. ROEBBER, D. G. MARSH, AND L. MUELLER. 1992. Proton resonance assignments and three-dimensional solution structure of the ragweed allergen Amb a V by nuclear magnetic resonance spectroscopy. Biochemistry 31: 8697-8705.
- GOODFRIEND, L., A.M. CHOUDHURY, J. DEL CARPIO, AND T.P. KING. 1979. Cytochromes C: New ragweed pollen allergens. Fed. Proc. 38: 1415.
- EKRAMODDOULLAH, A. K. M., F. T. KISIL, AND A. H. SEHON. 1982. Allergenic cross reactivity of cytochrome c from Kentucky bluegrass and perennial ryegrass pollens. Mol. Immunol. 19: 1527-1534.
- ANSARI, A. A., E. A. KILLORAN, AND D. G. MARSH. 1987. An investigation of human response to perennial ryegrass (Lolium perenne) pollen cytochrome c (Lol p X). J. Allergy Clin. Immunol. 80: 229-235.
- MORGENSTERN, J.P., I.J. GRIFFITH, A.W. BRAUER, B.L. ROGERS, J.F. BOND, M.D. CHAPMAN, AND M. KUO. 1991. Amino acid sequence of Fel d I, the major allergen of the domestic cat: protein sequence analysis and cDNA cloning. Proc. Natl. Acad. Sci. USA 88: 9690-9694.
- GRIFFITH, I.J., S. CRAIG, J. POLLOCK, X. YU, J.P. MORGENSTERN, AND B.L. ROGERS. 1992. Expression and genomic structure of the genes encoding FdI, the major allergen from the domestic cat. Gene 113: 263-268.
- WEBER, A., L. MARZ, AND F. ALTMANN. 1986. Characteristics of the asparagine-linked oligosaccharide from honeybee venom phospholipase A2. Comp. Biochem. Physiol. 83B: 321-324.

18. WEBER, A., H. SCHRODER, K. THALBERG, AND L. MARZ. 1987. Specific interaction of IgE antibodies with a carbohydrate epitope of honeybee venom phospholipase A2. *Allergy* 42: 464-470.
19. STANWORTH, D. R., K. J. DORRINGTON, T. E. HUGLI, K. REID, AND M. W. TURNER. 1990. Nomenclature for synthetic peptides representative of immunoglobulin chain sequences. *Bull. WHO* 68: 109-111.
20. RAJAN, T. I., J. GRIFFITH, M. C. KUO, J. F. BOND, B. L. ROGERS, AND D. G. KLAPPER. 1991. Cloning of Amb a I (antigen I), the major allergen family of short ragweed pollen. *J. Biol. Chem.* 266: 1229-1236.
21. ROGERS, B. L., J. P. MORGENTHAU, L. J. GRIFFITH, X. B. YU, C. M. COUNSELL, A. W. BRAUER, T. P. KING, R. D. GARMAN, AND M. C. KUO. 1991. Complete sequence of the allergen Amb a II: recombinant expression and reactivity with T cells from ragweed allergic patients. *J. Immunol.* 147: 2547-2552.
22. KLAPPER, D. G., L. GOODFRIEND, AND J. D. CAPRA. 1980. Amino acid sequence of ragweed allergen Ra3. *Biochemistry* 19: 5729-5734.
23. GHOSH, B., M. P. PERRY, T. RAJAN, AND D. G. MARSH. 1993. Cloning and expression of immunologically active recombinant Amb a V allergen of short ragweed (*Ambrosia artemisiifolia*) pollen. *J. Immunol.* 150: 5391-5399.
24. ROEBBER, M., R. HUSSAIN, D. G. KLAPPER, AND D. G. MARSH. 1983. Isolation and properties of a new short ragweed pollen allergen, Ra6. *J. Immunol.* 131: 706-711.
25. LUBAHN, B., AND D. G. KLAPPER. 1993. Cloning and characterization of ragweed allergen Amb a VI (abst). *J. Allergy Clin. Immunol.* 91: 338.
26. ROEBBER, M., AND D. G. MARSH. 1991. Isolation and characterization of allergen Amb a VII from short ragweed pollen. *J. Allergy Clin. Immunol.* 87: 324.
27. ROGERS, B. L., J. POLLOCK, D. G. KLAPPER, AND L. J. GRIFFITH. 1993. Cloning, complete sequence, and recombinant expression of a novel allergen from short ragweed pollen (abst). *J. Allergy Clin. Immunol.* 91: 339.
28. GOODFRIEND, L., A. M. CHOUDHURY, D. G. KLAPPER, K. M. COULTER, G. DORVAL, J. DELCARPIO, AND C. K. OSTERLAND. 1985. Ra5G, a homologue of Ra5 in giant ragweed pollen: isolation, III A-DR-associated activity and amino acid sequence. *Mol. Immunol.* 22: 899-906.
29. NILSEN, B. M., K. SUTTEN, M. O'NEILL, B. SMESTED PAULSEN, AND H. VAN HALBEK. 1991. Structural analysis of the glycoprotein allergen Art v II from pollen of mugwort (*artemisia vulgaris*). *J. Biol. Chem.* 266: 2660-2668.
30. MATTHIEN, F., M. SCHUMACHER, AND H. LOWENSTEIN. 1991. Characterization of the major allergen of *Cynodon dactylon* (Bermuda grass) pollen. *J. Allergy Clin. Immunol.* 88: 763-774.
31. SMITH, P. M., M. B. SINGH, AND R. B. KNOX. 1993. Characterization and cloning of the major allergen of Bermuda grass, Cyn d I. In: "Molecular Biology and Immunology of Allergens" (D. Kraft and A. Schon, eds.). CRC Press, Boca Raton, pp. 157-166.
32. MECHERI, S., G. PETRE, AND B. DAVID. 1985. Purification and characterization of a major allergen from *Dactylis glomerata* pollen. The Ag Dg I. *Int. Arch. Allergy Appl. Immunol.* 78: 283-289.
33. ROBERTS, A. M., I. J. BIVAN, P. S. FLORA, I. JEPSON, AND M. R. WALKER. 1993. Nucleotide sequence of cDNA encoding the Group II allergen of cocksfoot orchard grass (*Dactylis glomerata*), Dac g II. *Eur. J. Allergy Clin. Immunol.* In press.
34. KLYSSNER, S., K. WELINDER, H. LOWENSTEIN, AND F. MATTHIEN. 1992. Group V allergens in grass pollen. IV. Similarities in amino acid compositions and amino terminal sequences of the group V allergens from *Lolium perenne*, *Poa pratensis* and *Dactylis glomerata*. *Clin. Exp. Allergy* 22: 491-497.
35. PEREZ, M., G. Y. ISHIOKA, L. E. WALKER, AND R. W. CHESNUT. 1990. cDNA cloning and immunological characterization of the rye grass allergen Lol p I. *J. Biol. Chem.* 265: 16210-16215.
36. GRIFFITH, I. J., P. M. SMITH, J. POLLOCK, P. THEERAKULPISUT, A. AVJIOGLU, S. DAVIES, T. HOUGH, M. B. SINGH, R. J. SIMPSON, L. D. WARD, AND R. B. KNOX. 1991. Cloning and sequencing of Lol p I, the major allergenic protein of rye-grass pollen. *FEBS Lett.* 279: 210-215.
37. ANSARI, A. A., P. SHENBAGAMURTHI, AND D. G. MARSH. 1989. Complete amino acid sequence of a *Lolium perenne* (perennial rye grass) pollen allergen, Lol p II. *J. Biol. Chem.* 264: 11181-11185.
38. ANSARI, A. A., P. SHENBAGAMURTHI, AND D. G. MARSH. 1989. Complete primary structure of a *Lolium perenne* (perennial rye grass) pollen allergen, Lol p III: Comparison with known Lol p I and II sequences. *Biochemistry* 28: 8665-8670.
39. SINGH, M. B., T. HOUGH, P. THEERAKULPISUT, A. AVJIOGLU, S. DAVIES, P. M. SMITH, P. TAYLOR, R. J. SIMPSON, L. D. WARD, J. MCCLUSKEY, R. PUY, AND R. B. KNOX. 1991. Isolation of cDNA encoding a newly identified major allergenic protein of rye-grass pollen: intracellular targeting to the amyloplast. *Proc. Natl. Acad. Sci.* 88: 1384-1388.
40. MATTHIEN, F., A. K. NIELSEN, T. J. SOGAARD, S. KLYSSNER, AND H. LOWENSTEIN. 1992. NH₂-terminal sequences of four immunoaffinity purified grass pollen allergens: Phl p I, Poa p I, Sec e I and Cyn d I (abst.). *Allergy (Suppl.)* 47: 31.
41. LAFFER, S., S. VRTALA, D. KRAFT, AND O. SCHEINER. 1992. cDNA cloning of a major allergen of rye (*Secale cereale*) and timothy grass (*Phleum pratense*). XVth Eur. Congress of Allergy and Clin. Immunol. Paris.
42. MATTHIEN, F., AND H. LOWENSTEIN. 1991. Group V allergens in grass pollens. I. Purification and characterization of the group V allergen from *Phleum pratense* pollen. Phl p V. *Clin. Exp. Allergy* 21: 297-307.
43. VRTALA, S., S. LAFFER, M. DUCHENE, D. KRAFT, O. SCHEINER, AND R. VALENTA. 1992. cDNA cloning of a major grass pollen allergen from timothy grass (*Phleum pratense*): identification as Phl p V, a protein with possible targeting to the amyloplast. XVth Eur. Congress of Allergy and Clin. Immunol. Paris.
44. PETERSON, A., W. M. BECKER, AND M. SCHLAACK. 1992. Characterization of isoforms of the major allergen Phl p V by immunoblotting and microsequencing. *Int. Arch. Allergy Immunol.* 98: 105-109.
45. BIFFE, A., W. M. BECKER, A. PETERSON, G. SCHRAMM AND M. SCHLAACK. 1993. Partial mRNA sequence of Phl p V. EMBL accession number X70942.
46. ESCH, R. E., AND D. G. KLAPPER. 1989. Isolation and characterization of a major cross-reactive grass group I allergenic determinant. *Mol. Immunol.* 26: 557-561.
47. OLSEN, E., L. ZHANG, R. D. HILL, F. T. KISIL, A. H. SEHON, AND S. MOHAPATRA. 1991. Identification and characterization of the Poa p IX group of basic allergens of Kentucky bluegrass pollen. *J. Immunol.* 147: 205-211.
48. AVJIOGLU, A., M. SINGH, AND R. B. KNOX. 1993. Sequence analysis of Sor h I, the group I allergen of Johnson grass pollen and its comparison to rye-grass Lol p I (abst.). *J. Allergy Clin. Immunol.* 91: 340.
49. BREITENFEDER, H., F. FERREIRA, A. REIKERSTORFER, M. DUCHENE, R. VALENTA, K. HOFFMANN-SOMMERGRUBER, C. EBNER, M. BREITENBACH, D. KRAFT, AND O. SCHEINER. 1992. Complementary DNA cloning and expression in *Escherichia coli* of A1n g I, the major allergen in

- pollen of alder (*Alnus glutinosa*). *J. Allergy Clin. Immunol.* 90: 909-917.
50. BREITENBERGER, H., K. PETTENBURGER, A. BITO, R. VALENTA, D. KRAFT, H. RUMPOLD, O. SCHEINER, AND M. BREITENBACH. 1989. The gene coding for the major birch pollen allergen Bet v I is highly homologous to a pea disease resistance response gene. *EMBO J.* 8: 1935-1938.
 51. VALENTA, R., M. DUCHENE, C. EBNER, P. VALENT, C. SILLABER, P. DEVILLER, F. FERREIRA, M. TEJLIK, H. EDELMANN, D. KRAFT, AND O. SCHEINER. 1992. Profilins constitute a novel family of functional plant pan-allergens. *J. Exp. Med.* 175: 377-385.
 52. LARSEN, J.N., P. STURMAN, AND H. IPSEN. 1992. PCR based cloning and sequencing of isogenes encoding the tree pollen major allergen Car b I from *Carpinus betulus*, hornbeam. *Mol. Immunol.* 29: 703-711.
 53. BREITENBERGER, H., F. FERREIRA, K. HOFFMAN-SOMMERGRUBER, C. EBNER, M. BREITENBACH, H. RUMPOLD, D. KRAFT, AND O. SCHEINER. 1993. Four recombinant isoforms of Cor a I, the major allergen of hazel pollen. *Eur. J. Biochem.* 212: 355-362.
 54. IPSEN, H., AND B.C. HANSEN. 1991. The NH₂-terminal amino acid sequence of the immunochemically partial identical major allergens of alder (*Alnus glutinosa*) Aln g I, birch (*Betula verrucosa*) Bet v I, hornbeam (*Carpinus betulus*) Car b I and oak (*Quercus alba*) Que a I pollens. *Mol. Immunol.* 28: 1279-1288.
 55. TANAI, M., S. ANDO, M. USUI, M. KURIMOTO, M. SAKAGUCHI, S. INOUE, AND T. MATUHASHI. 1988. N-terminal amino acid sequence of a major allergen of Japanese cedar pollen (Cry j I). *FEBS Lett.* 239: 329-332.
 56. GRIFFITH, I.J., A. LUSSIER, R. GARMAN, R. KOURY, H. YEUNG, AND J. POLLOCK. 1993. The cDNA cloning of Cry j I, the major allergen of *Cryptomeria japonica* (Japanese cedar) (abst). *J. Allergy Clin. Immunol.* 91: 339.
 57. SAKAGUCHI, M., S. INOUE, M. TANAI, S. ANDO, M. USUI, AND T. MATUHASHI. 1990. Identification of the second major allergen of Japanese cedar pollen. *Allergy* 45: 309-312.
 58. GRIFFITH, I. Personal communication; Immunologic Pharmaceutical Corp.
 59. CARDABA, B., D. HERNANDEZ, E. MARTIN, B. DE ANDRES, V. DEL POZO, S. GALLARDO, J.C. FERNANDEZ, R. RODRIGUEZ, M. VILLALBA, P. PALOMINO, A. BASOMBA, AND C. LAHOZ. 1993. Antibody response to olive pollen antigens: association between HLA class II genes and IgE response to Ole e I (abst). *J. Allergy Clin. Immunol.* 91: 338.
 60. VILLALBA, M., E. BATANERO, C. LOPEZ-OTIN, L.M. SANCHEZ, R.I. MONSALVE, M.A. GONZALEZ DE LA PEÑA, C. LAHOZ, AND R. RODRIGUEZ. 1993. Amino acid sequence of Ole e I, the major allergen from olive tree pollen (*Olea europaea*). *Eur. J. Biochem.* 216: 863-869.
 61. CHUA, K. Y., G. A. STEWART, AND W. R. THOMAS. 1988. Sequence analysis of cDNA encoding for a major house dust mite allergen. *Der p I*. *J. Exp. Med.* 167: 175-182.
 62. CHUA, K. Y., C. R. DOYLE, R. J. SIMPSON, K. J. TURNER, G. A. STEWART, AND W. R. THOMAS. 1990. Isolation of cDNA coding for the major mite allergen Der p II by IgE plaque immunoassay. *Int. Arch. Allergy Appl. Immunol.* 91: 118-123.
 63. STEWART, G.A., L.D. WARD, R.J. SIMPSON, AND P.J. THOMPSON. 1992. The group III allergen from the house dust mite *Dermatophagoides pteronyssinus* is a trypsin-like enzyme. *Immunology* 75: 29-35.
 64. LAKE, F.R., L.D. WARD, R.J. SIMPSON, P.J. THOMPSON, AND G.A. STEWART. 1991. House dust mite-derived amylase: Allergenicity and physicochemical characterisation. *J. Allergy Clin. Immunol.* 87: 1035-1042.
 65. TOVEY, E. R., M. C. JOHNSON, A. L. ROCHE, G. S. COBON, AND B. A. BALDO. 1989. Cloning and sequencing of a cDNA expressing a recombinant house dust mite protein that binds human IgE and corresponds to an important low molecular weight allergen. *J. Exp. Med.* 170: 1457-1462.
 66. YASUDA, H., T. SHIDA, T. ANDO, S. SUGIYAMA, AND H. YAMAKAWA. 1991. Allergenic and proteolytic properties of fourth allergens from *Dermatophagoides* mites. In: "Dust mite allergens and asthma. Report of the 2nd international workshop". A. Todt, Ed., UCB Institute of Allergy, Brussels, Belgium, pp. 63-64.
 67. SHEN, H.-D., K.-Y. CHUA, K.-L. LIN, K.-H. HSIEH, AND W.R. THOMAS. 1993. Molecular cloning of a house dust mite allergen with common antibody binding specificities with multiple components in mite extracts. *Clin. Exp. Allergy*. In press.
 68. LIND, P., O.C. HANSEN, AND N. HORN. 1988. The binding of mouse hybridoma and human IgE antibodies to the major fecal allergen, Der p I of *D. pteronyssinus*. *J. Immunol.* 140: 4256-4262.
 69. DILWORTH, R. J., K. Y. CHUA, AND W. R. THOMAS. 1991. Sequence analysis of cDNA coding for a major house dust allergen Der f I. *Clin. Exp. Allergy* 21: 25-32.
 70. NISHIYAMA, C., T. YUNKI, I. TAKAI, Y. OKUMURA, AND H. OKUDAIRA. 1993. Determination of three disulfide bonds in a major house dust mite allergen, Der f II. *Int. Arch. Allergy Immunol.* 101: 159-166.
 71. TRUDINGER, M., K. Y. CHUA, AND W. R. THOMAS. 1991. cDNA encoding the major dust mite allergen Der f II. *Clin. Exp. Allergy* 21: 33-38.
 72. HEYMANN, P.W., M.D. CHAPMAN, R.C. AALBERSE, J.W. FOX, AND T.A.E. PLATT-MILLS. 1989. Antigenic and structural analysis of group II allergens (Der f II and Der p II) from house dust mites (*Dermatophagoides* spp.). *J. Allergy Clin. Immunol.* 83: 1055-1067.
 73. VAN HAGE-HAMSTEN, M., T. BERGMAN, E. JOHANSSON, B. PERSSON, H. JORNVALL, B. HARFASST, AND S.G.O. JOHANSSON. 1993. N-terminal amino acid sequence of major allergen of the mite *Lepidoglyphus destructor* (abst). *J. Allergy Clin. Immunol.* 91: 353.
 74. DE GROOT, H., K.G.H. GOEL, P. VAN SWIETEN, AND R.C. AALBERSE. 1991. Affinity purification of a major and a minor allergen from dog extract: Serologic activity of affinity-purified Can f I and of Can f I-depleted extract.
 75. KONIECZNY, A. Personal communication; Immunologic Pharmaceutical Corp.
 76. McDONALD, B., M. C. KEO, J. L. OHMAN, AND L. J. ROSENWASSER. 1988. A 29 amino acid peptide derived from rat alpha 2u globulin triggers murine allergen specific human T cells (abst). *J. Allergy Clin. Immunol.* 83: 251.
 77. CLARKE, A. J., P. M. CISOOLD, R. A. SHAW, P. BEATTIE, AND J. BISHOP. 1984. Structure of mouse urinary protein genes: differential splicing configurations in the 3'-non-coding region. *EMBO J.* 3: 1045-1052.
 78. LONGBOTTOM, J. L. 1983. Characterization of allergens from the urines of experimental animals. *Macmillan Press, London*, 525-529.
 79. LAPERCHE, Y., K. R. LYNCH, K. P. DOLANS, AND P. FEIGELSEN. 1983. Tissue-specific control of alpha 2u globulin gene expression: constitutive synthesis in submaxillary gland. *Cell* 32: 453-460.
 80. ARRUDA, L.K., B.J. MANN, AND M.D. CHAPMAN. 1992. Selective expression of a major allergen and cytotoxin, Asp f I in *Aspergillus fumigatus*. *J. Immunol.* 149: 3554-3559.
 81. KUMAR, A., L.V. REDDY, A. SOCHANIK, AND V.P. KURUP. 1993. Isolation and characterization of a recombinant heat shock protein of *Aspergillus fumigatus*. *J. Allergy Clin. Immunol.* 91: 1024-1030.
 82. TESHIMA, R., H. IKEBUCHI, J. SAWADA, S. MIYACHI, S.

- KITANI, M., IWAMA, M., IRIE, M., ICHINOE, AND T. TERAOKA. 1993. Isolation and characterization of a major allergenic component (gp55) of *Aspergillus fumigatus*. *J. Allergy Clin. Immunol.* 92: 698-706.
83. SHEN, H.D., K.B. CHOO, H.H. LEE, J.C. HSIEH, AND S.H. HAN. 1991. The 40 kD allergen of *Candida albicans* is an alcohol dehydrogenase: molecular cloning and immunological analysis using monoclonal antibodies. *Clin. Exp. Allergy* 21: 675-681.
84. MATTHIJSSEN, F., M. OLSEN, AND H. LÖWENSTEIN. 1992. Purification and partial sequence of the major allergen of *Alternaria alternata*, Alt a 1. *J. Allergy Clin. Immunol.* 89: 241.
85. CURRAN, I.H.A., N.M. YOUNG, M. BURTON, AND H.M. VIJAY. 1992. Purification and partial characterization of a low molecular weight antigen from *Alternaria alternata* (abst.). *J. Allergy Clin. Immunol.* 89: 283.
86. VIJAY, H.M., N.M. YOUNG, I.H.A. CURRAN, D.F. COPELAND, AND I.L. BERNSTEIN. 1993. A major antigen of *Alternaria alternata* with potential for safe and effective immunotherapy. *J. Allergy Clin. Immunol.* 91: 826-828.
87. DEVELL, B., L.K. ARRUDA, M.L. HAYDEN, M.D. CHAPMAN, AND T.A.E. PLATTES-MILLS. 1991. Trichophyton tonsurans allergen I. *J. Immunol.* 147: 96-101.
88. KUCHLER, K., M. GMACHL, M. J. SIPP, AND G. KREIL. 1989. Analysis of the cDNA for phospholipase A2 from honey bee venom glands: The deduced amino acid sequence reveals homology to the corresponding vertebrate enzymes. *Eur. J. Biochem.* 184: 249-254.
89. GMACHL, M., AND G. KREIL. 1993. Bee venom hyaluronidase is homologous to a membrane protein of mammalian sperm. *Proc. Natl. Acad. Sci. USA* 90: 3569-3573.
90. HABERMANN, E. 1972. Bee and wasp venoms. *Science* 177: 314-322.
91. JACOBSON, R.S., AND D.R. HOFFMAN. 1993. Characterization of bumblebee venom allergens (abst.). *J. Allergy Clin. Immunol.* 91: 187.
92. ARRUDA, L.K., L.D. VAILES, AND M.D. CHAPMAN. 1993. Molecular cloning of cockroach (*B. germanica*) allergens (abst.). *J. Allergy Clin. Immunol.* 91: 188.
93. MAZUR, G., X. BAUR, AND V. LIEBERS. 1990. Hypersensitivity to hemoglobins of the Diptera family Chironomidae: Structural and functional studies of their immunogenic allergenic sites. *Monog. Allergy* 28: 121-137.
94. Soldatova, L., L. Kochoumian, AND T.P. KING. 1993. Sequence similarity of a hornet (*D. maculata*) venom allergen phospholipase A1 with mammalian lipases. *FEBS Lett.* 320: 145-149.
95. LU, G., L. KOCHOUMIAN AND T.P. KING. Whiteface hornet venom allergen hyaluronidase: cloning and its sequence similarity with other proteins (abst.). *J. Allergy Clin. Immunol.* 93: 224.
96. FANG, K. S. F., M. VITALE, P. FEHLNER, AND T. P. KING. 1988. cDNA cloning and primary structure of a white-faced hornet venom allergen, antigen 5. *Proc. Natl. Acad. Sci. USA* 85: 895-899.
97. KING, T. P., D. C. MORAN, D. F. WANG, L. KOCHOUMIAN, AND B.T. CHAIT. 1990. Structural studies of a hornet venom allergen antigen 5, Dol m V, and its sequence similarity with other proteins. *Protein Sequences Data Analysis* 3: 263-266.
98. LU, G., M. VILLALBA, M.R. COSCIA, D.R. HOFFMAN, AND T.P. KING. 1993. Sequence analysis and antigen cross reactivity of a venom allergen antigen 5 from hornets, wasps and yellow jackets. *J. Immunol.* 150: 2823-2830.
99. KING, T. P. 1992. Unpublished data.
100. HOFFMAN, D.R. 1993. Allergens in Hymenoptera venom XXV: The amino acid sequences of antigen 5 molecules and the structural basis of antigenic cross-reactivity. *J. Allergy Clin. Immunol.* 92: 707-716.
101. HOFFMAN, D.R. 1992. Unpublished data.
102. HOFFMAN, D. R. 1993. The complete amino acid sequence of a yellow jacket venom phospholipase (abst.). *J. Allergy Clin. Immunol.* 91: 187.
103. JACOBSON, R.S., D.R. HOFFMAN, AND D.M. KEMENY. 1992. The cross-reactivity between bee and vespid hyaluronidases has a structural basis (abst.). *J. Allergy Clin. Immunol.* 89: 292.
104. HOFFMAN, D.R. 1993. Allergens in Hymenoptera venom XXIV: The amino acid sequences of imported fire ant venom allergens Sol i II, Sol i III, and Sol i IV. *J. Allergy Clin. Immunol.* 91: 71-78.
105. SCHMIDT, M., R.B. WALKER, D.R. HOFFMAN, AND T.J. MCCONNELL. 1993. Nucleotide sequence of cDNA encoding the fire ant venom protein Sol i II. *FEBS Lett.* 319: 138-140.
106. ELSAYED, S., S. APOLD, K. AAS, AND H. BENNICHT. 1976. The allergenic structure of allergen M from cod. Tryptic peptides of fragment TM1. *Int. Arch. Allergy Appl. Immunol.* 52: 59-63.
107. HOFFMAN, D. R. 1983. Immunochemical identification of the allergens in egg white. *J. Allergy Clin. Immunol.* 71: 481-486.
108. LANGELAND, T. 1983. A clinical and immunological study of allergy to hen's egg white. IV. Specific IgE antibodies to individual allergens in hen's egg white related to clinical and immunological parameters in egg-allergic patients. *Allergy* 38: 493-500.
109. DAUL, C.B., M. SLATTERY, J.E. MORGAN, AND S.B. LEHRER. 1993. Common Crustacea allergens: identification of B cell epitopes with the shrimp specific monoclonal antibodies. In: "Molecular biology and immunology of allergens" (D. Kraft and A. Sehon, eds.). CRC Press, Boca Raton, pp. 291-293.
110. RAO, P.V.S., K.N. SHANTI, B. MARTIN, G. VEKATRAMAN, S. NAGPAL, AND D.D. METCALFE. 1993. Tropomyosin is the major shrimp allergen (abst.). *J. Allergy Clin. Immunol.* 91: 341.
111. MONSALVE, R.I., M.A. GONZALEZ DE LA PENA, L. MENENDEZ-ARIAS, C. LOPEZ-OTIN, M. VILLALBA, AND R. RODRIGUEZ. 1993. Characterization of a new mustard allergen, Bra j IE. Detection of an allergenic epitope. *Biochem. J.* 293: 625-632.
112. MENA, M., R. SANCHEZ-MONGE, L. GOMEZ, G. SALCEDO, AND P. CARBONERO. 1992. A major barley allergen associated with baker's asthma disease is a glycosylated monomeric inhibitor of insect α -amylase: cDNA cloning and chromosomal location of the gene. *Plant Mol. Biol.* 20: 451-458.
113. MENENDEZ-ARIAS, L., I. MONEO, J. DOMINGUEZ, AND R. RODRIGUEZ. 1988. Primary structure of the major allergen of yellow mustard (*Sinapis alba* L.) seed. *Sin a I. Eur. J. Biochem.* 177: 159-166.
114. CHRISTIE, J. F., B. DUNBAR, I. DAVIDSON, AND M. W. KENNEDY. 1990. N-terminal amino acid sequence identity between a major allergen of *Ascaris lumbricoides* and *Ascaris suum* and MHC-restricted IgE responses to it. *Immunology* 69: 596-602.
115. CZUPPON, A.B., Z. CHEN, S. RENNERT, T. ENGELKE, H.E. MEYER, M. HEBER, AND X. BAUR. 1993. The rubber elongation factor of rubber trees (*Hevea brasiliensis*) is the major allergen in latex. *J. Allergy Clin. Immunol.* 92: 690-697.

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