

REVIEW

Defining allergens of mammalian origin

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Introduction

Several mammals live in human habitations, either as pets or livestock. In addition, rodents and rabbits are often kept in research facilities where technical personnel handle them. The animals all secrete proteins that will be potentially allergenic to the persons inhaling particles carrying the molecules. Several of these allergens have been identified and a few are moderately well characterized.

In recent years progress has been made primarily with regard to understanding the molecular structure of the major cat allergen *Fel d I* and the major dog allergen *Ag 13* (now tentatively named *Can f I*).

With the aim of easing communication between researchers the International Union of Immunological Societies (IUIS) allergen nomenclature committee has published a list of allergen molecules officially accepted as fulfilling the criteria for naming [1]. Since the list was published a few changes have been introduced by the scientific community although they have not been officially accepted. The name *Can f I* (from dog) is still tentative, as are the names *Mus m I* and *II* from mouse, *Cav p I* and *II* from guinea-pig and *Ory c I* from rabbit. The old names *Rat n I* and *II* are now generally accepted as *Rat n IA* and *IB*.

This review focuses on the molecular characterization of allergen molecules and does not describe in detail clinical studies and investigations of the immune response to individual allergens during exposure or hyposensitization.

Cat (*Felis domesticus*)

Epidemiology

Cats are popular pets in Western communities and the animal is found in approximately one out of four households in the general population [2–4]. Allergy to cat has been demonstrated in between 2 and 30% of the general population as determined by skin prick test and/or specific IgE *in vitro*. The prevalence of cat allergy varies

from one study to another depending on differences in age group, methods used and the criteria of positivity in the diagnostic method.

Allergen sources

Allergenic activity has been demonstrated in extracts of cat dander and pelt [5,7–16], serum [5–7,11], urine [6,12,13,15] and saliva [6,13–15,17]. Cat extracts used for diagnosis and specific immunotherapy are generally prepared from hair that has been cut close (approx 1 mm) to the skin surface without severing the tissue, or from pelt that contains a relatively high amount of serum proteins including albumin.

Allergen molecules

Several molecules in cat extracts have been shown to be allergenic [5,6] and the relative concentration of these allergens varies depending on the source of extract, e.g. dander, pelt and serum. It seems biologically unlikely that different cat-breeds should exhibit breed specific allergen molecules, as all cats belong to the same species. It is, however, conceivable that variation in the relative concentration of allergens occurs between short hair and long hair races for example.

Fel d I The most important allergen from a clinical point of view is *Fel d I* (formerly Cat 1 or Ag 4) which has been demonstrated in several studies [5,6,9–11]. *Fel d I* occurs in several tissues, i.e. salivary glands [17,18], pelt [9,17,18], hair follicles and even brain [9,17]. The molecule is furthermore found secreted into saliva and lacrimal fluid. One study indicated the presence of homologous molecules in other members of the *Felidae* family, e.g. lion and tiger [19]. The biological role of the allergen remains to be established.

The *Fel d I* molecule is responsible for a large proportion of the cat specific IgE elicited in cat allergic patients. Depletion studies have demonstrated that more than 50% of the cat dander RAST activity was carried by *Fel d I* [6,20] and that 66% of the histamine releasing activity of cat hair and dander extract was caused by *Fel d I* [21].

Biochemical studies have shown that *Fel d I* is a tetrameric polypeptide with an apparent mol.wt of 35–

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that a clear definition of related allergen groups can be difficult at the protein level.

Several allergens from pollen sources, e.g. *Bet v* I from birch (*Betula verrucosa*) occur in isoallergenic forms with only minor variations [98–100] that are readily distinguishable in two-dimensional electrophoresis. A few mammalian allergens, e.g. *Mus m* I has been noted to have different pI-variations [65,66] which are also likely to be isoallergenic forms.

With the advent of rDNA and gene-cloning techniques a new approach to allergen research dawns. These techniques could provide insight into allergen grouping, isoallergenic variation and molecular relatedness, even though gene based allergen characterization has its drawbacks too.

The future holds a promise of understanding the nature of the allergic immune response and its regulation. Basic studies into novel therapeutic strategies based on interfering with the immunological mechanisms of allergy is bound to benefit from well characterized allergen molecules of known epitope structure.

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References

- 1 Marsh DG, Goodfriend L, King TP, Løwenstein H, Platts-Mills TAE. Allergen nomenclature. Bull WHO 1986; 64:767–70.
- 2 Kjellman B, Pettersson R. The problem of furred pets in childhood atopic disease. Allergy 1983; 38:65.
- 3 Popp W, Rauscher H, Sertl K, Wanke T, Zwich H. Risk factor for sensitization to furred pets. Allergy 1990; 45:75.
- 4 Wood RA, Eggleston PA, Lind P, Ingeman L, Schwartz B, Gravesen S, Terry D, Wheeler B, Adkinson NF. Antigenic analysis of household-dust samples. Am Rev Respir Dis 1988; 137:358.
- 5 Ohman JL, Lowell FC, Bloch KJ, Kendall S. Allergens of mammalian origin. V. Properties of extracts derived from the domestic cat. Clin Allergy 1976; 6:419–28.
- 6 Løwenstein H, Lind P, Weeke B. Identification and clinical significance of allergenic molecules of cat origin. Part of the DAS 76 Study. Allergy 1985; 40:430–41.
- 7 Ohman JL, Kendall S, Lowell FC. IgE antibody to cat allergens in an allergic population. J Allergy Clin Immunol 1977; 60:317.
- 8 Wuthrich B, Arrendal H. RAST in the diagnosis of hypersensitivity to dog and cat allergens. A comparison of different extract preparations with clinical history, skin test and provocation tests. Clin Allergy 1979; 9:191.
- 9 Ohman JL, Lowell FC, Bloch KJ. Allergens of mammalian origin. III. Properties of a major feline allergen. J Immunol 1974; 113:1668.
- 10 Varga JM, Ceska M. Characterization of allergen extracts by polyacrylamide gel isoelectrofocusing and radioimmunosorbent allergen assay. II. Cat and dog allergens. Int Arch Allergy Appl Immunol 1972; 42:438.
- 11 Løwenstein H. Allergene von Katze, Hund, Rind und Pferd. Allergologie 1981; 4:265.
- 12 Hoffman DR. Dog and cat allergens: urinary proteins or dander proteins? Ann Allergy 1980; 45:205.
- 13 Viander M, Valovirta E, Vanto T, Koivikko A. Crossreactivity of cat and dog allergen extracts. RAST inhibition studies with special reference to the allergenic activity in saliva and urine. Int Arch Allergy Appl Immunol 1983; 71:252–60.
- 14 Didierlaurent A, Foglietti MJ, Guérin B, Hewitt BE, Percheron F. Comparative study on cat allergens from fur and saliva. Int Arch Allergy Appl Immunol 1984; 73:27–31.
- 15 Anderson MC, Baer H. Allergenicity active components of cat allergen extracts. J Immunol 1981; 127:972–5.
- 16 Wallenbeck I, Einarsson R. Identification of dander-specific and serum-specific allergens in cat dandruff extract. Ann Allergy 1987; 59:131–4.
- 17 Brown PR, Leitermann KM, Ohman JL. Distribution of cat allergen I in cat tissues and fluids. Int Arch Allergy Appl Immunol 1984; 74:67–70.
- 18 Bartholome K, Kissler W, Baer H, Kopiez-Schulte E, Wahn U. Where does cat allergen I come from? J Allergy Clin Immunol 1985; 76:503–6.
- 19 Groot H de, Swieten P van, Aalberse RC. Evidence for A *Fel d* I-like molecule in the 'big cats' (*Felidae* species). J Allergy Clin Immunol 1990; 86:107–16.
- 20 Groot H de, Swieten P van, Leeuwen J van, Lind P, Aalberse RC. Monoclonal antibodies to the major feline allergen *Fel d* I. I. Serologic and biologic activity of affinity-purified *Fel d* I and of *Fel d* I-depleted extract. J Allergy Clin Immunol 1988; 82:778–86.
- 21 Kleine-Tebbe J, Kleine-Tebbe A, Jeep S, Schou C, Løwenstein H, Kunkel G. The role of the major allergen (*Fel d* I) in patients, sensitized to cat allergens. Submitted.
- 22 Leitermann K, Ohman JL. Cat allergen I: biochemical, antigenic and allergenic properties. J Allergy Clin Immunol 1984; 74:147–53.
- 23 Chapman MD, Aalberse RC, Brown MJ, Platts-Mills TAE. Monoclonal antibodies to the major feline allergen *Fel d* I. Immunology 1988; 140:812–18.
- 24 Duffort OA, Carreira J, Nitti G, Polo F, Lombardero M. Studies on the biochemical structure of the major cat allergen *Felis domesticus* I. Mol Immunol 1991; 28:301–9.
- 25 Morgenstern JP, Griffith IJ, Brauer AW, Rogers BL, Bond JF, Chapman MD, Kuo Mei-chang. Amino acid sequence of *Fel d* I, the major allergen of the domestic cat: protein sequence analysis of cDNA cloning. Proc Nat Acad Sci 1991; 88:9690–4.
- 26 Lombardero M, Carreira J, Duffort O. Monoclonal antibody based radioimmunoassay for the quantitation of the main cat allergen (*Fel d* I or *Cat* I). J Immunol Methods 1988; 108:71–6.

- 27 Milligen FJ van, Swieten P van, Aalberse RC. Variability of *Fel d I* structure in commercial cat allergen extracts as revealed by monoclonal antibodies to denatured *Fel d I*. *Allergy Clin Immunol* 1991; suppl 1:198.
- 28 Greenstein JL. Molecular and cellular studies of the human immune response to allergens. American Academy of Allergy and Immunology 1991 Meeting, Workshop C308.
- 29 Lind P, Schwartz B. Enzyme-linked immunosorbent assay (ELISA) for major cat allergen, *Fel d I* (= Ag I) in house dust samples. *J Allergy Clin Immunol* 1987; 79:211. Abstract.
- 30 Wood RA, Chapman MD, Adkinson NF, Eggleston PA. The effect of cat removal on allergen content in household-dust samples. *J Allergy Clin Immunol* 1989; 83:730-4.
- 31 Luczynska CM, Yin Li, Chapman MD, Platts-Mills TAE. Airborne concentrations and particle size distribution of allergen derived from domestic cats (*Felis domesticus*). *Am Rev Respir Dis* 1990; 141:361-7.
- 32 Blay F de, Chapman MD, Platts-Mills TAE. Airborne cat allergen (*Fel d I*). Environmental control with the cat *in situ*. *Am Rev Respir Dis* 1991; 143:1334-9.
- 33 Metre TE van, Marsh DG, Adkinson NF, Fish JE, Kagey-Sobotka A, Norman PS, Radden EB, Rosenberg GL. Dose of cat (*Felis domesticus*) allergen 1 (*Fel d I*) that induces asthma. *J Allergy Clin Immunol*, 1986; 78:62-75.
- 34 Boutin Y, Hébert H, Vrancken ER, Mourad W. Allergenicity and cross-reactivity of cat and dog allergenic extracts. *Clin Allergy*, 1988; 18:287-93.
- 35 Duffort O, Carreira J, Lombardero M. Characterization of the main IgE-binding components of cat dander. *Int Arch Allergy Appl Immun* 1987; 84:339-44.
- 36 Stokes CR, Turner MW. Isolation and characterization of cat allergens. *Clin Allergy* 1975; 5:241-54.
- 37 Brighton WD von, Topping MD, Berry JB. Allergene aus Katzenfell. *Allergologie*, 1981; 5: 270-5.
- 38 Brehm K, Plock K, Doepp M, Baier H. Antigenität des Serumalbumins bei Allergie gegen Katzen- und Hundepithelien. *Dtsch med Wschr* 1975; 100:472-6.
- 39 Ickovic MR, Rabillon J, Dandeu JP, David B. Human hypersensitivity to cat allergens: *Fel d I* and serum albumin. *Allergy Clin Immunol*, suppl No. 1, 1991:198 (Abstract).
- 40 Dandeu JP, Rabillon J, Guillaume JL, Camoin L, Lux M, David B. Isolation and purification of cat albumin from cat serum by copper ion affinity chromatography: further analysis of its primary structure. *J Chromatography* 1991; 539:475-84.
- 41 Lind P, Norman PS, Newton M, Løwenstein H, Schwartz B. The prevalence of indoor allergens in the Baltimore area: house dust mite and animal-dander antigens measured by immunochemical techniques. *J Allergy Clin Immunol* 1987; 80:541-7.
- 42 Dybendal T, Vik H, Elsayed S. Dust from carpeted and smooth floors. II. Antigenic and allergenic content of dust vacuumed from carpeted and smooth floors in schools under routine cleaning schedules. *Allergy* 1989; 44:401-11.
- 43 Munir AKM, Andersson R, Einarsson R, Schou C, Dreborg S. Allergens in school dust. I. The amount of the major cat (*Fel d I*) and dog (*Can f I*) allergens in dust from Swedish schools is high enough to probably cause perennial symptoms in most asthmatic children sensitized to cat and dog. Submitted.
- 44 Haahntela T, Jaakonmaki I. Relationship of allergen-specific IgE antibodies, skin prick tests and allergic disorders in unselected adolescents. *Allergy* 1981; 36:251-6.
- 45 Vanto T, Koivikko A. Dog hypersensitivity in asthmatic children. *Acta Paediatr Scand*, 1983;72:571-5.
- 46 Blands J, Løwenstein H, Weeke B. Characterization of extract of dog hair and dandruff from six different dog breeds by quantitative immunoelectrophoresis. Identification of allergens by crossed radioimmuno-electrophoresis (CRIE). *Acta Allergologica* 1977; 32:147-69.
- 47 Uhlin T, Reuterby J, Einarsson R. Antigenic/allergenic composition of poodle/alsation dandruff extract. *Allergy* 1984; 39:125-33.
- 48 Ford AW, Alterman L, Kemeny DM. The allergens of dog. I. Identification using crossed radio-immuno-electrophoresis. *Clin Exp Allergy* 1989; 19:183-90.
- 49 Groot H de, Goei KGH, Swieten P van, Aalberse RC. 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. *J Allergy Clin Immunol* 1991; 87:1056-65.
- 50 Lindgren S, Belin L, Dreborg S, Einarsson R, Pålman I. Breed-specific dog-dandruff allergens. *J Allergy Clin Immunol* 1988; 82:196-204.
- 51 Larsen JN, Ford A, Gjesing B, Levy D, Petrunov B, Silvestri L, Løwenstein H. The collaborative study of the international standard of dog, *Canis domesticus*, hair/dander extract. *J Allergy Clin Immunol* 1988; 82:318-30.
- 52 Schou C, Svendsen UG, Løwenstein H. Purification and characterization of the major dog allergen, *Can f I*. *Clin Exp Allergy* 1991; 21:321-8.
- 53 Schou C, Hansen GN, Lintner T, Løwenstein H. Assay for the major dog allergen *Can f I*: Investigation of house dust samples and commercial dog extracts. *J Allergy Clin Immunol* 1991; 88:847-53.
- 54 Yman L, Brandt R, Ponterius G. Serum albumin—an important allergen in dog epithelia extracts. *Int Arch Allergy* 1973; 44:358-68.
- 55 Vanto T, Viander M, Schwartz B. The importance of dog serum albumin as an allergen in dog dander sensitive asthmatic children. *Allergologia et Immunopathologia* 1980; 8:405 (Abst).
- 56 Vanto T, Viander M, Schwartz B. Dog serum albumin as an allergen. *Int Arch Allergy Appl Immun* 1982; 69:311-15.
- 57 Newman-Taylor AJ. Laboratory animal allergy. *Eur J Respir Dis* 1982; 63:123:60-4.
- 58 Gross NJ. Allergy to laboratory animals: epidemiologic, clinical and physiologic aspects, and a trial of cromolyn in its management. *J Allergy Clin Immunol* 1980; 66:158-65.
- 59 Davies GE, McArdle LA. Allergy to laboratory animals: a survey by questionnaire. *Int Arch Allergy Appl Immunol* 1981; 64:302-7.

- 60 Schumacher MJ, Tait BD, Holmes MC. Allergy to murine antigens in a biological research institute. *J Allergy Clin Immunol* 1981; 68:310-18.
- 61 Venables KM, Tee RD, Hawkins ER, Gordon DJ, Wale CJ, Farrer NM, Lam TH, Baxter PJ, Taylor AJN. Laboratory animal allergy in pharmaceutical company. *Br J Indust Med* 1988; 45:660-6.
- 62 Twiggs JT, Agarwal MK, Dahlberg MJE, Yunginger JW. Immunochemical measurement of airborne mouse allergens in a laboratory animal facility. *J Allergy Clin Immunol* 1982; 69:522-6.
- 63 Swanson MC, Agarwal MK, Reed CE. An immunochemical approach to indoor aeroallergen quantitation with a new volumetric air sampler: studies with mite, roach, cat, mouse, and guinea pig antigens. *J Allergy Clin Immunol* 1985; 76:724-9.
- 64 Sakaguchi M, Inouye S, Miyazawa H, Kamimura H, Kimura M, Yamazaki S. Evaluation of countermeasures for reduction of mouse airborne allergens. *Laboratory Animal Science* 1990; 40:613.
- 65 Schumacher MJ. Characterization of allergens from urine and pelts of laboratory mice. *Mol Immunol* 1980; 17:1087-95.
- 66 Lorusso JR, Moffat S, Ohman JL. Immunologic and biochemical properties of the major mouse urinary allergen (*Mus m* I). *J Allergy Clin Immunol* 1986; 78:928-37.
- 67 Price AJ, Longbottom JL. Allergy to mice. I. Identification of two major mouse allergens (Ag 1 and Ag 3) and investigation of their possible origin. *Clin Allergy* 1987; 17:43-53.
- 68 Price JA, Longbottom JL. Allergy to mice. II. Further characterization of two major mouse allergens (Ag 1 and Ag 3) and immunohistochemical investigations of their sources. *Clin Exp Allergy* 1990; 20:71-7.
- 69 Gurka G, Ohman J, Rosenwasser LJ. Allergen-specific human T-cell clones: derivation, specificity, and activation requirements. *J Allergy Clin Immunol* 1989; 83:945-54.
- 70 Finlayson JS, Asofsky R, Potter M, Runner CC. Major urinary protein complex of normal mice: origin. *Science* 1965; 149:981-2.
- 71 Ruoslahti E, Engvall E, Jalanko H, Comings DE. Antigenic differences in nuclear proteins of normal liver and hepatoma. Identification of a nuclear protein present in hepatocytes but absent in hepatoma cells. *J Exp Med* 1977; 146:1054-67.
- 72 Siraganian RP, Sandberg AL. Characterization of mouse allergens. *J Allergy Clin Immunol* 1979; 63:435-42.
- 73 Walls AF, Longbottom JL. Quantitative immunoelectrophoretic analysis of rat allergen extracts. *Allergy* 1983; 38:419-31.
- 74 Longbottom JL, Austwick PKC. Allergy to rats: quantitative immunoelectrophoretic studies of rat dust as a source of inhalant allergen. *J Allergy Clin Immunol* 1987; 80:243-51.
- 75 Eggleston PA, Newill CA, Ansari AA, Pustelnik A, Sheau-Rong L, Evans R, Marsh DG, Longbottom JL, Corn M. Task-related variation in airborne concentrations of laboratory animal allergens: studies with *Rat n* I. *J Allergy Clin Immunol* 1989; 84:347-52.
- 76 Longbottom JL. Crossed radio-immunoelectrophoresis as a method of identifying isoallergens: identification of isoallergens in rat urine extracts. *J Immunol Methods* 1984; 68:297-304.
- 77 Walls AF, Longbottom JL. Comparison of rat fur, urine, saliva and other rat allergen extracts by skin testing, RAST, and RAST inhibition. *J Allergy Clin Immunol*, 1985; 75:242-51.
- 78 Lutsky I, Fink JN, Kidd J, Dahlberg MJE, Yunginger JW. Allergenic properties of rat urine and pelt extracts. *J Allergy Clin Immunol* 1985; 75:279-84.
- 79 Eggleston PA, Ansari AA, Ziemann B, Adkinson NF, Corn M. Occupational challenge studies with laboratory workers allergic to rats. *J Allergy Clin Immunol* 1990; 86:63-72.
- 80 Wahn U, Peters T, Siraganian RP. Studies on the allergenic significance and structure of rat serum albumin. *J Immunol* 1980; 125:2544-9.
- 81 Walls AF, Taylor AJN, Longbottom JL. Allergy to guinea pigs: II identification of specific allergens in guinea pig dust by crossed radio-immunoelectrophoresis and investigation of the possible origin. *Clin Allergy* 1985; 15:535-46.
- 82 Swanson MC, Agarwal MK, Yunginger JW, Reed CE. Guinea-pig-derived allergens. Clinicoimmunologic studies, characterization, airborne quantitation, and size distribution. *Am Rev Respir Dis* 1984; 129:844-9.
- 83 Walls AF, Taylor AJN, Longbottom JL. Allergy to guinea pigs: I allergenic activities of extracts derived from the pelt, saliva, urine and other sources. *Clin Allergy* 1985; 15:241-51.
- 84 Price JA, Longbottom JL. Allergy to rabbits II. *Allergy* 1988; 43:39-48.
- 85 Price JA, Longbottom JL. Allergy to rabbits I. *Allergy* 1986; 41:603-12.
- 86 Warner JA, Longbottom JL. Allergy to rabbits III. *Allergy* 1991; 46:481-91.
- 87 Pahl P, Roed-Petersen J. Type I allergy from cows in veterinary surgeons. *Contact Dermatitis* 1979; 5:33.
- 88 Pahl P, Weeke B, Løwenstein H. Quantitative immunoelectrophoretic analysis of extract from cow hair and dander. *Allergy* 1978; 33:241-53.
- 89 Pahl P, Bucher D, Plesner T, Weeke B, Løwenstein H. Isolation and partial characterisation of three major allergens in an extract from cow hair and dander. *Int Arch Allergy Appl Imm* 1982; 67:293-301.
- 90 Wahn U, Peters T, Siraganian RP. Allergenic and antigenic properties of bovine serum albumin. *Mol Immunol* 1981; 18:19-28.
- 91 Løwenstein H, Markussen B, Weeke B. Isolation and partial characterization of three major allergens of horse hair and dandruff. *Int Arch Allergy Appl Immun* 1976; 51:48-67.
- 92 Løwenstein H, Markussen B, Weeke B. Identification of allergens in extract of horse hair and dandruff by means of

- crossed radioimmuno-electrophoresis. *Int Arch Allergy Appl Immun* 1976; 51:38-47.
- 93 Løwenstein H. Characterization and chemical modification of isolated allergens from horse hair and dandruff. *Int Arch Allergy Appl Immun*, 1978; 57:349-357.
- 94 Wahn U, Herold U, Danielsen K, Løwenstein H. Allergo-prints in horse allergic children. *Allergy* 1982; 37:335-43.
- 95 Matthiesen F, Løwenstein H. 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* 1991; 21:297-307.
- 96 Silvanovich A, Astwood J, Zhang L, Olsen E, Kisil F, Schon A, Mohapatra S, Hill R. Nucleotide sequence analysis of three cDNAs coding for *Poa p* IX isoallergens of Kentucky Bluegrass pollen. *J Biol Chem* 1991; 266:1204-10.
- 97 Thomas W. Grass under scrutiny. *Clin Exp Allergy* 1991; 21:255-7.
- 98 Florvaag E, Elsayed S, Hammer ASE. Comparative studies on tree pollen allergens. XIII. Partial characterization of the alder (*Alnus glutinosa*) pollen extract by two-dimensional IEF/SDS-PAGE electrophoresis combined with electrophoretic transfer and immunoautoradiography. *Int Arch Allergy Appl Immunol* 1986; 80:26-32.
- 99 Florvaag E, Holen E, Vik H, Elsayed S. Comparative studies on tree pollen allergens. Characterization of the birch (*Betula verrucosa*) and hazel (*Corylus avellana*) pollen extracts by horizontal 2D SDS-PAGE combined with electrophoretic transfer and IgE immunoautoradiography. *Ann Allergy* 1988; 61:393-400.
- 100 Rohac M, Birkner T, Reimitzer I, Bohle B, Steiner R, Breitenbach M, Kraft D, Scheiner O, Gabl F, Rumpold H. The immunological relationship of epitopes on major tree pollen allergens. *Mol Immunol* 1991; 28:897-906.