

Hypersensitivity to Foods among Birch Pollen-Allergic Patients

Immunochemical Inhibition Studies for Evaluation of Possible Mechanisms*

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Several statistical investigations have indicated that an immunological partial identity might exist between birch pollen and some foods because of the existence of concurrent hypersensitivity symptoms to both sources. In order to study this, two groups of BP (birch pollen)-allergic patients (20 with (F+) and 20 without (F-) food hypersensitivity) were skin prick tested with extracts of various foods prepared in different ways. Sera from these patients were inhibited with different foods, including a lectin, Con A (concanavalin A), before analysis in BP-RAST and -CRIE. Corresponding experiments using sera from grass pollen allergies were performed as controls. The two groups of patients showed identical skin reactivities to BP extract whereas the F+ patients bound twice as much BP-specific IgE in RAST and CRIE as the F- patients. BP-RAST performed with sera from F+ patients were in some cases inhibited with foods and Con A; corresponding BP-CRIE were not. Neither BP-RAST (with one exception) nor -CRIE performed with sera from F- patients were inhibited with foods and Con A. TP (timothy pollen)-RAST performed with sera from timothy allergic patients were inhibited with some foods and with Con A; corresponding TP-CRIE were not. Controls performed on sera from normal individuals revealed no inhibition at all in the BP and TP systems. As no direct evidence for immunological partial identity was found from these results the clinical hypersensitivity against some foods among BP-allergics are discussed particularly regarding content of lectin in foods and common carbohydrate components in pollen allergens and food molecules.

Key words: birch pollen; CRIE; food hypersensitivity; hay fever; lectins; RAST.

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Patients with birch pollen (BP) allergy often report hypersensitivity symptoms from eating or handling nuts and various fruits and roots. Hannuksela & Lahti (13) using fresh food materials in a modified scratch test found positive immediate skin reactions in 35% of BP-allergic patients. The foods most frequently giving positive reactions were parsnip, apple, potato, carrot and celery. According to an inquiry study (10), the following foods were related to BP-allergy: hazel nut, walnut, Brazil nut, al-

mond, apple, peach, cherry, pear, plum, carrot and potato. The more pronounced the BP-allergy according to skin test, provocation test or RAST, the higher was the incidence of food hypersensitivity, reaching about 80% in the group with the strongest reactions.

The explanation of the relationship between BP-allergy and these various food hypersensitivities is not clear. As far as hazel nut hypersensitivity is concerned, cross reacting allergens might be the mechanism responsible. Belin (6),

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using passive hemagglutination inhibition technique, as well as Andersen & Løwenstein (4) employing the crossed line immunoelectrophoresis technique, have demonstrated the occurrence of partial immunological identity between antigens of BP and hazel nut. As far as other allergens are concerned, the explanation is more uncertain. Andersen & Løwenstein (4) found no partial identity between antigens of BP and extracts or fresh peel from apples and potatoes. On the other hand, Lahti et al. (14) using RAST inhibition technique have demonstrated that BP extract inhibits the RAST activity of apple allergic sera – using apple seed preparation as allergosorbent – while the opposite experiment failed (7).

Lectins, a group of proteins with group specificity for terminal oligosaccharide configurations on glycoproteins, are present in more than 800 different plants (8) including many foods of vegetable origin such as potato, rice, wheat, barley, beans (including soya and castor), apples, plums, mirabelles, citrus, cress and peanuts. Siraganian & Siraganian (25) demonstrated that the lectin Concanavalin A (Con A) can cause a higher histamine release from basophil leucocytes from allergic patients than from normal persons. That mast cells and basophils were stimulated to release histamine by lectins was further demonstrated using Con A (18, 21), wheat germ agglutinin (5) and the lectins from *Ricinus c.* (5) and *Glycine m.* (5). Recently, Sehr & Luther (24) demonstrated the effect of *Viscum* lectin on histamine release from human leucocytes. These studies indicated both interactions between lectins and the Fc-part of IgE – causing a pseudo-allergic histamine release (5, 18, 25) – and interactions directly with the cell membrane (24). Finally, Aalberse (1) demonstrated that IgE in some human sera reacts with an antigen present in a large number of unrelated foods as well as pollens; this antigen was periodate-sensitive and heat-stable.

The aim of the present study was to evaluate the possible explanations for the relationship between BP allergy and hypersensitivity reactions to some foods. For this purpose, BP-allergic patients, who, on the basis of a question-

naire, were divided into two groups: one with and one without food intolerance, were skin prick tested and their sera were analyzed for presence of BP-specific IgE, using RAST and CRIE, and inhibition experiments were performed using BP, apple and potato allergens as well as a lectin, Con A, as inhibitors.

MATERIAL AND METHODS

Patients. From among hay fever patients undergoing routine investigation at the allergy diagnostic unit, 40 BP-allergics were selected: 20 patients without (group F–), and 20 patients with food intolerance (group F+). The mean age of the patients in the two groups was 28 (15–62) and 30 (17–55) years, respectively, and the proportion of males/females was 14/6 and 9/11. The duration of their hay fever was 12 (1–36) years in group F– and 9 (2–40) years in group F+. Besides their BP-allergy, 14 individuals in group F– and eight in group F+ had a grass pollen allergy.

Serum samples for RAST inhibition and CRIE experiments from pools of sera from these patients (cf. Table 4) or from timothy pollen allergics (previously described in (15)) were stored at –20°C until used.

Skin prick tests (SPT) with pollen and food allergens were performed on the volar side of the forearms. The reactions were read after 15 min and graded according to the recommendations of the Standardization Committee of the Northern Society of Allergology (2).

Case histories regarding food intolerance were obtained from questionnaires in which about 40 different foods were listed.

Allergen extracts. The birch pollen (BP), batch 1815/907072, and timothy pollen (TP), batch 730/907073, extracts used were standardized, glycerinated extracts of *Betula verrucosa* and *Phleum pratense* pollen (Soluprick®-SQ, ALK, Copenhagen, Denmark), activities given in HEP-units (3). Extracts of BP denoted Bp 0275 and Bp 0778, and extract of *Phleum pratense* denoted Pp 0280 were prepared as described recently for timothy (15). Extract of horse hair

and dander denoted H 0275 was prepared as described elsewhere (19). For prick tests BP extracts with an activity of 1 HEP were used.

Other pollen extracts used in skin tests were alder, hazel, elm, aspen, linden, beech, oak, saw, bog-myrtle, meadow foxtail and mugwort (Neo Helisen extract, '5000 PNU/ml, Merck, Darmstadt, FRG). Extract of hazelnut was obtained from the Allergy Laboratory, Sahlgren's Hospital, Gothenburg, Sweden. Extracts of other food allergen sources – peanut, apple, tomato, celery, potato peel, potato without peel, potato with peel and aleuron, and potato with aleuron were obtained from ALK, Copenhagen, Denmark. (Allergen strength 1:20 w/v).

Extracts from new potatoes and new apples were obtained as described recently (4) as follows: At a temperature of 5°C, fresh peelings were blended with a minimum of buffer (0.125 M ammonium bicarbonate, 0.015 M sodium azide, 1% (v/v) approtinin (a protease inhibitor from NOVO, Mainz, FRG), pH 7.6, filtrated and centrifuged at 0°C for 60 min at 50000 g. The supernatant was filtered through an 0.65 µ pore filter and 1) stored frozen at -20°C until use, denoted *potato (fresh)* and *apple (fresh)*; 2) dialysed twice against a 50-fold volume of 0.005 M ammonium bicarbonate, 0.015 M sodium azide, and then once against water for 24 h at 5°C. The dialysed products were then lyophilised and stored at 5°C, and denoted *potato (FD)* and *apple (FD)*. Extract of apple was also prepared exactly as described recently (7) followed by dialysis against water (50-fold outer volume, 24 h at 5°C) and lyophilised, and was denoted *apple (PVPP)*. Concanavalin A (Con A) was obtained from Pharmacia, Uppsala, Sweden, and dissolved (3 mg/ml) in 85 mM sodium chloride, 30 mM sodium bicarbonate/glycerol, 50% (v/v) before use.

Antibodies used for immunoelectrophoresis in CRIE denoted a-Bp 0275, bleed 14–55 were raised by immunizing rabbits, bleeding and subsequent purification according to the methods of Harboe & Ingild (16). Labelled (^{125}I), immunoabsorbed, polyclonal anti-IgE (ε chain specific) was prepared as described by Løwenstein & Weeke (17).

Radioallergosorbenttest (RAST) was performed as described by Ceska et al. (9) using paper discs as solid support. Couplings of BP, TP, Bp 0275, Bp 0778 and H 0275 to the paper discs were performed at the concentrations given in Table 1. The assay using the BP discs was carried out on each serum from the 40 birch-allergic patients as well as on a control serum composed of sera from 1000 normal individuals. The other discs were used only in inhibition experiments (see below). The results were calculated as per cent of total activity (^{125}I a-IgE added to the discs) and given in a score system from 0–4 corresponding to: below 1, from 1 to 2, from 2 to 4, from 4 to 8, and above 8% of total activity bound.

RAST inhibition experiments were performed as described by Nielsen et al. (20) using the inhibitors at the various concentrations given in Table 1.

The results of the RAST inhibition were expressed as allergenic activity =

$$\frac{C^{50\%} \text{ ref}}{C^{50\%}} \times 100 \text{ (per cent)},$$

where $C^{50\%}$ refers to the concentration corresponding to 50% inhibition with the reference (birch or timothy) and with the various food extracts.

Crossed radioimmuno-electrophoresis. Crossed immunoelectrophoresis for CRIE and CRIE inhibition was performed on 5 × 7 cm glass plates (16) in the antigen/antibody systems given in Table 2.

CRIE was performed essentially as described in Løwenstein (15), using 125 µl from same serum samples as described for the RAST assay. The autoradiographies were carried out in 16 days and the results given in an arbitrary score system from 1–4 corresponding to increasing visible radiostaining.

CRIE inhibitions were performed using the same inhibitors as for the RAST inhibition but only the highest concentration was used. A review of CRIE inhibition experiments is given in Table 2.

Table 1
RAST inhibition experiments

Solid phase		Inhibitors		
Antigen	Conc. of coupling	Sera	Antigen	Concentrations
BP	665 µg/ml	1. Serum Nos. 17, 34, 37, 38 from group F-	Potato (FD)	3, 0.3, 0.03 mg/ml
		2. Pool of group F-	Apple (FD)	3, 0.3, 0.03 mg/ml
		3. Serum Nos. 2, 9, 12, 26 from group F+	Apple (PVPP)	UD, 1:10, 1:100
		4. Pool of group F+	Potato (fresh)	UD, 1:10, 1:100
		5. Pool of 1000 normal sera	Apple (fresh)	UD, 1:10, 1:100
TP	300 µg/ml	1. Pool of sera from timothy-allergic patients	Con A	3, 0.3, 0.03 mg/ml
		2. Pool of 1000 normal sera	Bp 0778	3, 0.3, 0.03 mg/ml
Bp 0275	1000 µg/ml	1. Pool of group F- and F+	Pp 0280	
Bp 0778	1000 µg/ml		Potato (FD)	3, 1, 0.3, 0.1, 0.03, 0.01 mg/ml
H 0275	1000 µg/ml		Apple (FD)	3, 1, 0.3, 0.1, 0.03, 0.01 mg/ml
		2. Sera from 10 horse-allergic patients		

UD = Undiluted.

Table 2
CRIE inhibition experiments

CRIE system			Inhibitors	
Ag	amount applied (µg)	ab/cm ² (µl)	Sera	(Conc. in parenthesis)
BP	16.6	3.6	1. Serum Nos. 17, 34, 37, 38 from group F-	Potato (FD) (3 mg/ml), Apple (FD) (3 mg/ml), Apple (PVPP) (UD), Potato (fresh) (UD), Apple (fresh) (UD), Con A (3 mg/ml), Bp 0778 (3 mg/ml)
			2. Pool of group F-	
			3. Serum Nos. 2, 9, 12, 26 from group F+	
			4. Pool of group F+	
			5. Pool of 1000 normal sera	
TP	35	4.6	6. Pool of sera from timothy-allergic patients	Potato (FD) (3 mg/ml), Apple (FD) (3 mg/ml), Apple (PVPP) (UD), Potato (fresh) (UD), Apple (fresh) (UD), Con A (3 mg/ml), Pp 0280 (3 mg/ml)
			7. Pool of 1000 normal sera	

Statistical comparisons between skin prick test results obtained by (F-) and (F+) in Table 3 were performed by means of Student tests; others (Table 4) by means of Mann Whitney tests.

RESULTS

Food hypersensitivity according to questionnaires. The foods, which according to the patients' histories most often gave symptoms, were, in

Table 3
Skin prick test results (No. of plusses)

Allergen	Patients without food intolerance (F-)		Patients with food intolerance (F+)		Significance of difference between the two groups
	Mean	SEM	Mean	SEM	
<i>Food allergens</i>					
Potato peel	0.30	0.13	0.74	0.24	*
Potato without peel	0.30	0.15	0.68	0.23	
Potato with peel					
and aleuron layer	0.25	0.14	0.84	0.24	*
Potato with aleuron layer	0.60	0.20	1.42	0.29	*
Hazel nut	0.85	0.23	2.06	0.30	*
Peanut	1.85	0.28	1.94	0.34	
Apple	0.05	0.08	0.28	0.16	
Tomato	0.25	0.14	0.22	0.17	
Celery	0.70	0.21	1.50	0.42	*
<i>Pollen allergens</i>					
Birch	3.40	0.27	3.70	0.33	
Alder	2.84	0.31	3.44	0.34	
Hazel	2.32	0.42	2.56	0.36	
Elm	0.61	0.27	0.28	0.18	
Aspen	0.83	0.28	0.94	0.31	
Linden	1.00	0.27	0.33	0.16	*
Beech	2.11	0.39	1.28	0.36	*
Oak	1.33	0.29	1.06	0.31	
Bog-myrtle	1.61	0.33	2.17	0.40	
Sallow	0.94	0.39	0.44	0.20	
Grass (meadow foxtail)	2.70	0.40	1.30	0.34	*
Mugwort	2.05	0.44	1.00	0.30	*

* = $P < 0.05$.

order of frequency: hazel nut, apple, potato, pear, cherry, walnut, peach and carrot. The symptom most frequently noticed was oral pruritus, reported by 16 of the 20 patients in group F+, and rhino-conjunctivitis, reported by 12 individuals in the F+ group. As a rule only fresh foods and not boiled or tinned foods gave rise to symptoms.

Prick test results. There was no significant difference between the two patient groups regarding the histamine weal diameters (4.38 ± 0.15 mm in group F- and 4.68 ± 0.18 mm in group F+) (cf. Table 4).

All patients were BP-allergics according to histories, skin tests, and/or nasal provocation tests. Only one patient had a negative SPT with BP allergen. Patients with food hypersensitivity (group F+) on an average had stronger (al-

though not statistically significant) skin reactions with BP and some other tree pollen allergens than patients without food hypersensitivity (Table 3). On the other hand, skin reactions with linden, beech, mugwort and grass pollen (meadow foxtail) were significantly weaker in the group F+ than in group F- (Table 3).

The SPT results with food allergens are shown in Tables 3 and 4. With most of the food extracts used, a tendency to stronger reactions was seen in the group with food hypersensitivity when compared with the other group. With hazel nut, celery, and with three of the potato extracts, including those containing aleuron layer, the difference was statistically significant.

Correlations between history and prick test. The correlation between the case histories and the SPT results with food allergens was very poor. Posi-

Table 4
Results of diagnostic tests performed on patients without (F-) and patients with (F+) food intolerance

Skin prick test									
Patient number	BP ¹ 1 HEP	Potato ¹				Apple ¹	Hist. chloride ² 1 g/l	RAST BP ³	CRIF BP ³
		peel	without peel	with peel and aleuron	with aleuron				
(F-) 3	4+	0	0	0	0	1+	4	0	3
7	5+	0	0	0	0	0	3.5	1	3
10	4+	1+	0	0	1	0	5	1	1
11	3+	0	0	0	0	0	5.5	3	3
13	4+	0	0	0	0	0	5	0	2
15	3+	0	0	0	0	0	4.5	1	2
16	2+	0	0	0	0	0	4	0	0
17	5+	0	0	0	0	1+	3.5	1	2
18	4+	0	0	0	0	0	5	0	0
19	3+	0	0	0	0	0	4	1	1
20	3+	0	0	0	0	0	4.5	0	0
23	3+	0	0	0	0	0	6	1	N.D.
30	3+	0	2+	1+	2+	0	4	2	4
32	4+	1+	1+	2+	1+	0	4	0	1
33	4+	0	0	0	1+	0	4.5	0	0
34	4+	2+	0	0	2+	0	4	4	4
36	2+	0	0	0	1+	0	4	0	0
37	5+	0	0	0	0	1+	4.5	1	1
38	2+	1+	2+	2+	3+	0	4	2	N.D.
39	1+	1+	1+	0	1+	0	4	1	0
Mean	3.4+	0.30+	0.30+	0.25+	0.60+	0.15+	4.38+	0.95	1.50
<i>P</i> ⁴	> 0.2	> 0.1	> 0.1	< 0.05	< 0.05	> 0.1	> 0.1	< 0.02	< 0.02
(F+) 1	3+	0	0	0	0	0	5	1	3
2	3+	0	0	2+	2+	0	6	4	4
4	4+	3+	2+	3+	3+	2+	5	4	4
5	6+	N.D.	N.D.	N.D.	N.D.	N.D.	4	0	1
6	5+	0	0	0	1+	0	5.5	3	4
8	4+	1+	2+	0	2+	1	6	2	2
9	3+	2+	2+	2+	2+	0	4	4	3
12	2+	2+	1+	1+	3+	2+	3.5	2	3
14	3+	2+	0	1+	2+	0	6	0	1
21	0	2+	3+	2+	3+	0	4.5	0	0
22	4+	0	0	3+	3+	0	5	4	4
24	2+	0	0	0	0	0	3.5	1	0
25	4+	0	0	0	0	0	5	2	4
26	3+	2+	1+	1+	2+	0	5	4	4
27	4+	0	0	0	0	0	4	1	3
28	6+	0	0	0	0	0	4	1	2
29	5+	0	0	0	0	N.D.	4	1	3
31	5+	0	0	0	0	0	5	2	3
35	5+	0	2+	1+	3+	0	4.5	3	4
40	3+	0	0	0	1+	0	4	2	4
Mean	3.7+	0.74+	0.68+	0.84+	1.42+	0.28+	4.68	2.05	2.80

¹ Grading according to Aas & Belin (1). See text for further details.

² Results given as mm diameter (mean of smallest and largest diameter).

³ Grading in classes from 0-4. See text for further details.

⁴ Mann-Whitney U-test.

Table 5

RAST/CRIE inhibition performed on sera from patients allergic to birch pollen without (F-) and with (F+) food intolerance and on sera from timothy-allergic patients and normal individuals

Patients	Allergosorbent/ Precipitate	Inhibitors ¹ (no inhibition = -; inhibition = +)							
		Potato (FD)	Apple (FD)	Con A	BP (TP) ²	Potato (fresh)	Apple (fresh)	Apple (PVPP)	Buffer
Group F-, 17	BP	-/-	-/-	-/-	-/+	-/-	-/-	-/-	-/-
34 (cf. Fig. 1)	BP	-/-	-/-	+/-	+/+	+/-	+/-	-/-	-/-
37	BP	-/-	-/-	-/-	-/+	-/-	-/-	-/-	-/-
38	BP	+/-	+/-	-/-	+/+	+/-	+/-	+/-	-/-
Pool of group F-	BP	-/-	-/-	-/-	-/+	-/-	-/-	-/-	-/-
Group F+, 2	BP	+/-	+/-	+/-	+/+	+/-	+/-	+/-	-/-
9	BP	-/-	+/-	-/-	+/+	+/-	+/-	+/-	-/-
12	BP	-/-	+/-	-/-	+/+	+/-	+/-	+/-	-/-
26	BP	-/-	+/-	+/-	+/+	+/-	-/-	+/-	-/-
Pool of group F+	BP	-/-	+/-	+/-	+/+	+/-	+/-	+/-	-/-
Pool of normal individuals	BP	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
Pool of timothy allergies	TP	-/-	-/-	+/-	+/+	+/-	+/-	-/-	-/-
Pool of normal individuals	TP	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-

¹ Concentrations as given in Tables 1 and 2. The tests were regarded as inhibited (+) when CPM in RAST were reduced more than 25%, or when significant reductions in CRIE radiostaining occurred - both relative to the results obtained when using buffer as inhibitor.

² TP used as inhibitor in the last two experiments.

tive prick test result combined with negative history and vice versa was often found. With some allergens (e.g. hazel nut and peanut) there were more falsely positive than falsely negative skin reactions. With others (e.g. apple) the situation was the opposite.

RAST and CRIE results are given in Table 4. In group F- (without food allergy) many of the BP allergic patients (8/20) had RAST class 0 which can be regarded as negative. Similarly, 6/18 tests in CRIE fell into class 0. In group F+ (with food allergy) 3/20 tested with RAST and 2/20 tested with CRIE fell into class 0. The mean of the results with both the RAST and CRIE performed on the two groups of patients differed approximately with a factor of 2, a statistically significant difference ($P < 0.01$).

Inhibition experiments. BP-RAST and BP-CRIE were inhibited with several food allergen ex-

tracts and Con A. The inhibitions were performed on selected patients and on pools of the two groups of patients (Table 5).

Comparison of the results obtained in the two groups revealed that neither food allergen extracts nor Con A were able to inhibit the reaction of BP-specific IgE in the RAST from group F- patients but could do so in most of the group F+ patients. Contrary to that, neither of the two groups were inhibited in binding their BP-specific IgE in CRIE. None of the selected individual sera analysed were inhibited by foods in CRIE whereas RAST inhibition was seen in both groups (most often in group F+). Also timothy pollen RAST was in some cases inhibited by food allergen extracts, including Con A, whereas timothy pollen CRIE was not.

Controls performed on sera from normal individuals showed no inhibition at all either in the BP- or in the TP-system.

Finally, attempts were made to inhibit BP

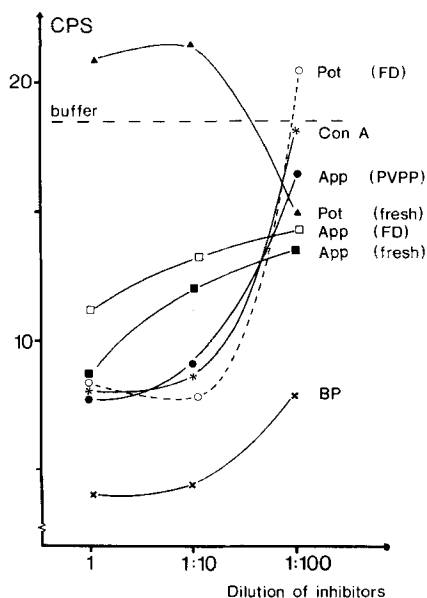


Fig. 1. Birch RAST inhibited with various foods given as counts per second (CPS) versus concentration of inhibitors. RAST was performed using a serum (patient 34) previously inhibited with various foods, Con A, BP and buffer as indicated in the figure. For details see Table 1.

RAST and horse RAST performed with a pool of group F- and F+ sera and with a pool of sera from horse allergics with various food allergen extracts (according to Table 1) as inhibitors. No inhibition was detected in either case.

Examples of RAST inhibition studies are shown in Fig. 1. In this example (patient 34) a clear inhibition of birch RAST with extract of apple (PVPP), potato (FD), Con A and birch was seen, whereas the inhibition with extracts of potato (fresh) and apples (FD) and (fresh) is doubtful or negative according to the definition of a positive inhibition given in Table 5.

Examples of CRIE inhibition studies are shown in Fig. 2. A clear inhibition is seen using the BP extract as inhibitor and no inhibition is seen when using the buffer or the various food allergen extracts as inhibitors.

DISCUSSION

Two groups of BP allergic patients: those with (F+) and those without (F-) food intolerance,

were selected on the basis of a questionnaire. The SPT reactivity was higher in group F+ with five out of the nine food allergens used. With five out of 10 tree-pollen allergens the SPT reactivity was numerically, although not statistically significantly, higher in group F+ than in group F-. On the other hand, with a grass pollen allergen, as well as with mugwort and two tree-pollen allergens, the SPT reactivity was statistically, significantly lower for group F+ than for F-. A similar negative correlation between grass pollen allergy and food intolerance has recently been described (10, 12) as well as a negative correlation between total IgE and food hypersensitivity in BP allergic patients (12). For our two groups of patients there seems to be no distinct difference in their skin reactivity towards pollen, and skin reactivity towards pollen does not identify food intolerant patients.

Whereas the *in vivo* (SPT) reactivities of F- and F+ towards BP differed insignificantly, a distinct difference was obtained for the *in vitro* (RAST and CRIE) reactivities giving proportions between mean values of roughly 1:2. Previously, correlation between food intolerance and BP RAST and SPT has been found (10, 11, 12). A possible explanation for the lacking correlation in SPT in the present study may be the relatively low number of patients (20 in each group). Provided food intolerance is due to partial identity between BP and food antigens (and the patient has cross-reacting IgE) a positive correlation should be expected. In a previous study (4) a partial identity between extracts of BP and apple and potato was not detected. This indicated that a correlation between food intolerance and BP allergy – as demonstrated in this study by means of RAST and CRIE – could not be explained by common allergenic epitopes on food and BP molecules. In the present study, the *in vitro* tests for BP allergy were inhibited by some foods and also by a well-characterized lectin, Con A, to which the patients probably have never been sensitized. The BP RAST were for some patients, particularly those from group F+, inhibited by foods. Con A inhibition appeared also in the F+ pool, whereas BP CRIE were not inhibited except by BP. It should, however, be emphasized that the

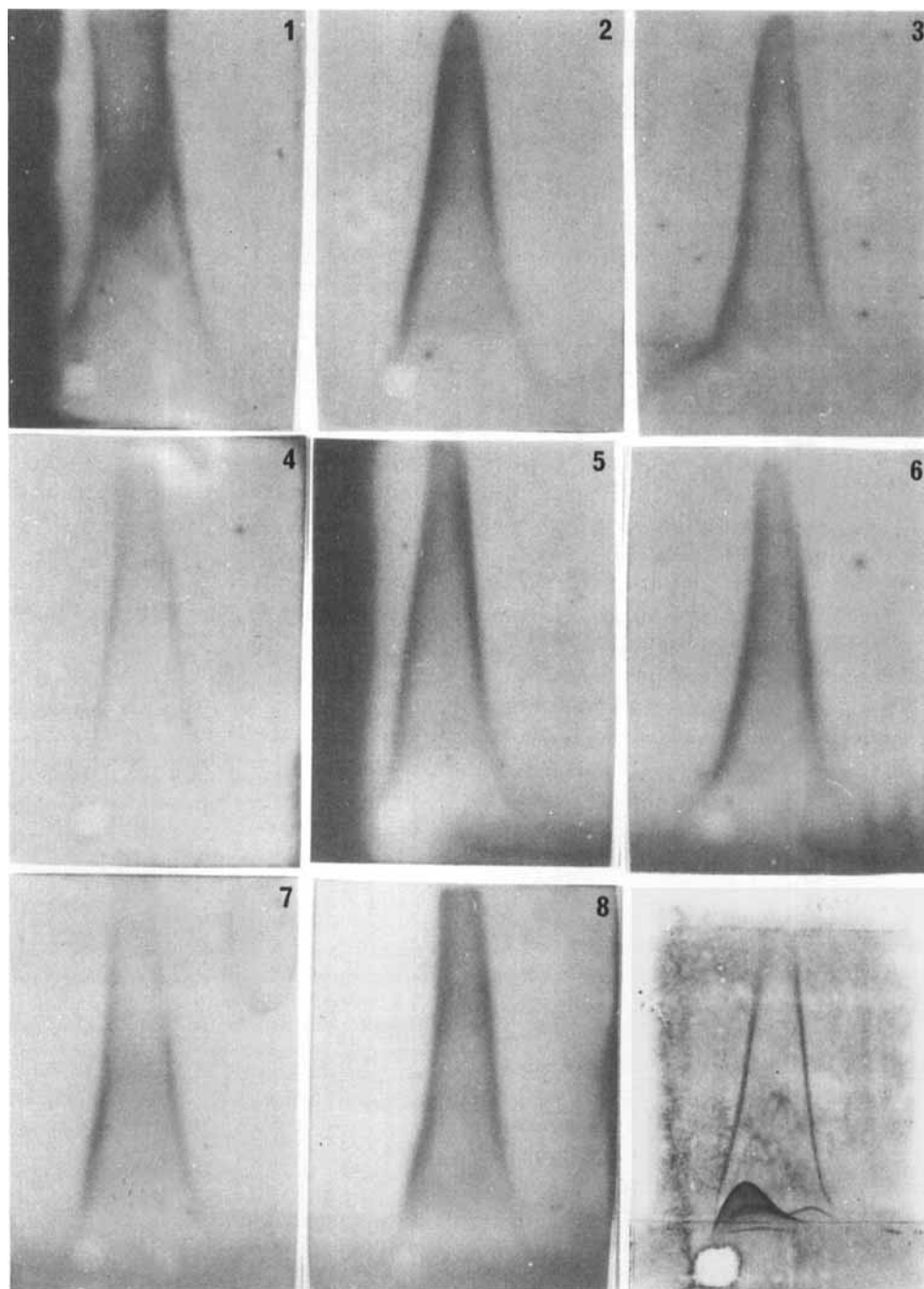


Fig. 2. Birch CRIE inhibited with various foods. Native immunoprecipitates of BP revealed by CIE (example shown bottom right) were subjected to CRIE using the pooled sera from Group F+ previously inhibited with potato (FD), apple (FD), con A, BP, potato (fresh), apple (fresh), apple (PVPP), and buffer as indicated in the figure (1-8). For details, see Table 2.

concentration of Con A (max. 3 mg/ml) was rather high. The inhibition of TP RAST and CRIE indicates the occurrence of the same mechanism as for BP in *in vitro* tests, whereas inhibition of horse RAST was not obtained with any foods as inhibitor.

Evidently the serum pools (F- and F+) differed in BP RAST activity with higher RAST in F+. RAST activity in the TP pool, which was composed of sera with RAST class 3-4, was thus more like F+ than F-. Both BP- (those with RAST ≥ 2) and TP-RAST were inhibited by foods; also BP (RAST = 4) and TP were inhibited by Con A, indicating that foods may contain lectins which can react with IgE causing a pseudo-allergic reaction.

The discrepancy between RAST and CRIE inhibitions performed with foods and Con A may be explained by the difference in affinity constants.

The paper discs covalently bind BP molecules which cannot be exchanged with other molecules. In the CIE precipitate in CRIE the BP antigens and rabbit Ig's are established in a lattice through non-covalent bonds with affinity constant of the same order of magnitude as that between BP antigens and human IgE (22, 23). Rabbit IgG can, depending on concentration, be exchanged with human IgE, the precipitate thus being able to bind radiolabelled anti-IgE. This chemical equilibrium will be influenced to a higher degree by addition of BP allergen to the BP-specific IgE-containing serum than by addition of lectin-like molecules in order to perform inhibition in CRIE.

Besides the lectin hypothesis, a recent study by Aalberse et al. (1) proposes another explanation which states that IgE with specificity against hydroxyproline-rich plant glycoproteins found in both pollen- and vegetable food-molecules are responsible for the RAST inhibition capacity of some foods. These authors found that IgE antibodies caused no symptoms and that they are clinically irrelevant, whereas half of our patients were included in the study because of clinically relevant food intolerance.

At present we cannot strictly argue for any mechanism explaining the hypersensitivity to foods among BP allergics. However, a partial

identity between pollen and food molecules was not shown, whereas the presence of molecules interacting with human IgE with affinities lower than allergenic epitopes is clearly indicated.

Recently, Dreborg & Fouchard (Allergy 38, 167-172, 1983) have shown that apple, carrot, potato and hazelnut reactivity from a birch pollen-allergic patient was transferable in Prausnitz-Küstner test. Their finding indicates that the birch pollen-related food hypersensitivity is mediated by reagents.

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