

Atopic allergic reactions due to raw potato

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A 24-year-old woman suffers from atopic allergic reactions because of the inhalation of finely dispersed particles of raw potatoes. Symptoms of the reaction are rhinorrhea, nasal blocking, sneezing, tickling, and pain in the throat. A localized atopic dermatitis is aggravated by the inhalation. Symptoms are evoked by old as well as by new potatoes. Cooked potatoes, however, are handled and eaten without difficulties. Direct scratch and intradermal tests with raw potato press juice and a passive transfer test (Prausnitz-Küstner) are positive. Intradermal tests with cooked potato are negative. Separation of the potato proteins was carried out by agar gel electrophoresis by means of a high-voltage technique. Scratch tests were performed with some of the different fractions. Positive reactions were obtained by both anionic and cationic fractions, but predominantly by two cationic protein compounds.

It is well known that foods may give rise to allergic symptoms in several different ways. Ingestion is certainly not the only way in which these reactions may be provoked. An interesting type of allergic reaction is caused by the inhalation of minute particles of food during preparation. A classic example of this type of allergy is baker's asthma, caused by inhalation of flour.^{1, 2} Recently we had the opportunity to observe another, less well-known example of this type of reaction.

Case history

The subject is a 24-year-old woman suffering from an eezematoid dermatitis localized since birth on the flexor sides of the extremities, especially at the knees and the elbows. Though there have been several remissions, the eruption has never completely cleared. During her first and so far only pregnancy a remarkable improvement was noticeable, but 3 weeks after delivery the eruption recurred in full force. Treatment with corticosteroid ointments resulted in a marked improvement of the eezema but not in a definite cure. There is no family history of allergy, and the only child has developed no allergic diseases so far.

At a recent visit the patient showed an erythematous and papular eezema on the flexor surface of the right forearm with numerous excoriated papules, as a result of scratching,

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but no lichenification. On being questioned, she mentioned a definite sensitivity to raw potatoes. This began at age 8 years when she was learning to peel potatoes. Even a few minutes in a room in which somebody has been peeling or scraping potatoes are enough: her nose becomes blocked and rhinorrhea and sneezing begin. The symptoms diminish within a few minutes after she has left the room. If the patient does not leave immediately, other symptoms occur, consisting of tickling and pain in the throat, coughing fits, wheezing, watering eyes, and an increased itching of the eczematous patches. She avoids these symptoms in her household by getting some other member of the family to prepare the potatoes. As soon as cooking is finished she can handle and eat the potatoes without ill effect. It is notable that the age of the potatoes makes no difference at all, the symptoms being elicited by old as well as by new potatoes.

Blood tests. The Wassermann, VDRL, and Reiter tests were negative; blood analysis was normal with 5 per cent eosinophils; and urine analysis was negative.

Skin tests. As a preliminary test, scratch tests with raw old and with cooked potatoes were performed. This resulted in a strong urticarial response with raw potato and a negative reaction with cooked potato. Scratch tests with raw potato on 20 control persons were negative. The Bencard test series was used for further testing, and positive reactions were found to fish (scratch test) and house dust (intracutaneous). All other tests, including those with potato extract from this series, were negative. The Bencard skin test series consists of 34 food allergens, 10 animal danders, 9 molds, 3 bacteria, and a number of pollens and miscellaneous allergens.

Further skin tests were performed with so-called "potato press juice" (p.p.j.). This can easily be prepared by squeezing raw potatoes through a nylon sieve. Because of the risk of deterioration of the sap during storage for a day or more, even in the refrigerator, we always used freshly prepared p.p.j. which we had left for 3 hours in the refrigerator. After that period a small, clear, brown surface layer had been formed which was used for testing (Table I).

Table I. Results of skin tests

<i>Test</i>	<i>Allergen</i>	<i>Result</i>
<i>Patient</i>		
Scratch	Pure p.p.j.	+ + +
Scratch	10% p.p.j.	+ +
Scratch	1% p.p.j.	+
Scratch	Pure p.p.j., heated ½ hour at 56°C.	+ + +
Scratch	Pure p.p.j., heated 10 min. at 100°C. (formed a coagulated protein mass with layers of different colors)	Negative
Scratch	Industrially made potato flour from 3 different sources	Negative
Intradermal	0.0001% p.p.j.	+ +
Intradermal	0.001% p.p.j.	+ + +
<i>Passive transfer (Prausnitz-Küstner)</i>		
Unheated serum	House dust (Bencard)	+ +
Unheated serum	0.0001% p.p.j.	+
Unheated serum	0.001% p.p.j.	+ +
Unheated serum	0.01% p.p.j.	+ + ±
Unheated serum	0.1% p.p.j.	+ + +
Heated serum (½ hr. at 56°C.)	All concentrations of p.p.j.	Negative
<i>Patient's 5-year-old child</i>		
Scratch	Pure p.p.j.	Negative

METHOD

The potato sap, which contains approximately 90 per cent of the proteins present in potato tubers,³ was prepared by using a juice centrifuge, which separated pulp from sap. After the starch was filtered off, the sap was clear and ready for use. Separation of potato proteins was carried out by electrophoresis. As supporting medium for the fractionation, agar gel was used as a 0.9 per cent solution in barbiturate buffer (pH 8.3 and an ionic strength of 0.05). At pH 8.3 most of the proteins can be considered to be negatively charged.

The micro high-voltage plate technique, according to Wieme,⁴ was used; however, instead of microscope slides, larger-sized plates measuring 3 by 12 cm. were used in order to obtain a better fractionation. The thickness of the agar layer was 1.7 mm. The application line was made 7 cm. from the cathodic end of the slide. According to the previously determined true protein content of the sap (range 0.6 to 2.5 per cent), a proportional quantity containing approximately 400 μ g of protein was applied. When the application was finished, the slides were placed upside down in a Wieme electrophoresis tank, the central part of which was filled with petroleum ether (boiling point, 30 to 40°C.). A metal tray filled with ice was placed above the petroleum ether. Thus the temperature in the tank could be kept constant during the entire fractionating process. A constant current of 25 Ma. per slide was used, which resulted in a maximum voltage of 200 volts (± 20 v. per centimeter) when the temperature was approximately 7°C. The running time was 80 to 90 minutes, and the total distance then covered was 9 cm., 5 cm. at the cathodic and 4 cm. at the anodal side of the application line. A saturated solution of amidoblack 10^B in ethanol-water-acetic acid (14:5:1) was used for staining the protein components.

After the electrophoretic procedure and the development of the agar gel slides, 12 to 15 protein fractions were visualized as discrete blue bands. These were found on both sides of the application line—in spite of the negative charge of the proteins at pH 8.3—because of the electro-osmotic flow, which is very strong in agar gel. Their different final locations in the gel are caused mainly by differences in charge densities of the constituent proteins. Besides being polypeptides, proteins also may contain prosthetic groups, which often determine their character (e.g., nucleo- and glucoproteins). It might be possible, therefore, that several visible fractions contain an identical prosthetic group connected to different proteins, as proteins determine the migration velocities. Another possibility is that fractionation is influenced by either polymerization or complex formation of proteins present in the sap.⁵ It has to be mentioned here that nothing is known yet about the character of the proteins separated in sap of potato tubers.

RESULTS

A sample of the variety *Eigenheimer* was used, which was harvested about 5 months before being tested. The protein components in the sap of the tubers were electrophoretically separated. The protein fractions in the agar gel were not fixated or stained. However, the agar layer was cut in such a way that

Table II. *Scratch tests with six different protein fractions in agar gel*

<i>Fraction</i>	<i>Result</i>
<i>Cathodic side</i>	
C1	+
C2	± +
C3	+ + +
C4	+ + +
Application line	
<i>Anodal side</i>	
A1	+
A2	+

well-separated groups of two fractions were obtained. The cuts were made—on the analogy of stained slides—between well-separated fractions. Scratch tests were carried out with six different fractions in agar gel, obtained from both sides of the application line, with the results shown in Table II. A control scratch test with agar gel was negative. Although there are positive reactions by both cationic and anionic fractions, two cationic fractions are found to be mainly responsible for the hypersensitivity phenomena.

DISCUSSION

The positive skin tests with p.p.j. demonstrate the presence of the atopic allergy. The provoking material apparently penetrates the nasal and pharyngeal mucosa. Utmost care on the part of the patient has prevented the occurrence of reactions of the lower respiratory tract. (As a matter of fact, the patient refused to take a provocative test, which is administered by the inhalation of finely dispersed p.p.j.) Because the patient avoided all contact with raw potatoes, it seems likely that the influence of the raw potato allergy on the existing atopic dermatitis is not of major importance, though it is certain that incidental inhalation worsened the eczema. It is interesting to note that some cases of potato allergy described in the literature⁶ were caused by the ingestion of cooked potatoes. Though they are only very occasionally mentioned in literature, allergic reactions to raw potatoes are perhaps more common than generally is supposed.⁷ In this case the peeling of old potatoes and the scraping of new ones cause similar symptoms. Pearson described 29 patients who developed allergic symptoms only when new potatoes were being scraped or peeled.⁷ His patients could handle old potatoes without ill effect.

The fact that the patient has reacted positively to different fractions obtained by electrophoresis does not necessarily mean that there is more than one reacting agent present in potato sap. It still may be possible that only one agent is responsible, which is present as a prosthetic group in several fractions. However, the assumption is then made that a prosthetic group rather than the protein moiety is the responsible material.

It is of interest that the allergen is not thermoresistant, as some authors (e.g., van der Bijl⁸) describe certain allergens as being rather thermoresistant.

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