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Soybean Oil Is Not Allergenic to Soybean-Sensitive Individuals

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Abstract

We have previously demonstrated that peanut oil is not allergenic to peanut-sensitive individuals. Seven soybean-sensitive patients were enrolled in a double-blind crossover study to determine whether ingestion of soybean oil can induce adverse reactions in such patients. All subjects had histories of systemic allergic reactions (urticaria, angioedema, wheezing, dyspnea, and/or vomiting) after soybean ingestion and had positive puncture skin tests with a 1:20 w/v glycerinated-saline whole soybean extract. Sera from six of the seven subjects were tested by RAST assay for the presence of specific IgE antibodies to soybean allergens. All patients had elevated levels of serum IgE antibodies to the crude soybean extract; binding values ranged from 2.3 to 28.1 times that of a negative control serum. Before the oral challenges, all patients demonstrated negative puncture skin tests to three commercially available soybean oils and to olive oil (control). On four separate days, patients were challenged with the individual soybean oils and to olive oil in random sequence. At 30-minute intervals, under constant observation, patients ingested 2, 5, and 8 ml of one of the soybean oils or olive oil contained in 1 ml capsules. No untoward reactions were observed with either the commercially available soybean oils or olive oil. Soybean oil ingestion does not appear to pose a risk to soybean-sensitive individuals.

Soybeans and soybean products are assuming a greater role in the American diet. With this change, allergic reactions to soybeans are on the rise. For children, soybean sensitivity is among the most common forms of food allergy.[1,2]

The most effective management of food allergy is careful avoidance of the offending allergen. This approach is increasingly difficult because soybean products appear in more and more foodstuffs. Presently, the soybean-sensitive patient is advised to avoid soybeans in all forms, including soybean oil. The recommendation to avoid soybean oil is not based on solid evidence because little is known of the allergenic nature of soybean oil. Therefore, the implementation of such advice may be unwarranted since soybean oil may be nonallergenic.

In a previous double-blind crossover challenge study,[3] we found that ingestion of peanut oil failed to elicit any adverse reaction among a group of peanut-sensitive individuals. This occurred because peanut oil lacks allergenicity. The lack of allergenicity of peanut oil is not particularly surprising since the allergenic activity of peanut resides within the protein fraction, and the oil contains no detectable protein residues. Similarly, soybean allergens appear to be proteinaceous,[4] and soybean oil is also devoid of protein.[5] Therefore, we would predict that soybean oil would not elicit an adverse reaction among soybean-allergic individuals. To confirm this hypothesis, we challenged seven soybean-sensitive patients with soybean oil.

Materials and Methods

Seven patients with a history of an immediate hypersensitivity reaction after ingestion of soybeans were recruited from the allergy clinics at the University of Wisconsin, Madison. A clinical summary of the seven patients is provided in Table I.

Table I. Clinical summary of patients

Patient			Atopic		Years since	Reaction after	Other legume
No.	Age	Sex	history*	Age at onset	last exposure	ingestion†	sensitivity‡
1	32	M	—	8	3	RD, U	GB, L, P, PN
2	63	F	—	56	2	AE, LE, W	—
3	18	F	A, AR, E	Infancy	6	AP, LE, U, W	LB, P, PN
4	21	M	A	8	3	AE, U, W	GB, P, PN
5	50	M	HS	30	< 1	AE, U, W	KB, L
6	38	F	A, AR	Infancy	10	R, U, W	LB, KB, PN
7	21	F	A, AR	20	< 1	RD, W	PN

*Atopic disease: A = asthma; AR = allergic rhinitis; E = eczema; HS = Hymenoptera sensitivity
†Reaction: AE = angioedema; AP = abdominal pain; LE = laryngeal edema; R = rhinitis; RD = respiratory distress; U = urticaria; W = wheezing
‡Legumes: GB = garbanzo bean; KB = kidney bean; L = lentil; LB = lima bean; P = pea; PN = peanut nut

Detection of IgE antibodies to soybean

Patients were skin tested with a crude whole soybean extract (l:20 w/v in 50% glycerine; Greer Laboratories, Lenoir, North Carolina) and the various challenge oils by the puncture

method. Serum IgE antibody levels to soybean allergens were determined by RAST[6] by use of microcrystalline cellulose as the solid phase sorbent and the crude soybean extract as the allergen.

Challenge materials

Three types of soybean oil were used for skin testing and the oral challenges: a partially hydrogenated oil (Crisco), a nonhydrogenated oil (from B. Szuhaj, Central Soy Co.), and a cold-pressed soybean oil (Hunza brand). Olive oil (Pompeian brand) provided a placebo control. It was chosen because it is an edible oil that is generally considered to be nonallergenic.[7] The individual oils were placed in separate gelatin capsules (1 ml per capsule), packaged in coded plastic bags so that neither the patient nor the physician would know which material was being administered, and frozen.

Challenge tests

The double-blind crossover trials were conducted on five separate days. On the first day, the patients received puncture skin tests with whole soybean extract and the individual oils. If the skin tests to the oils were negative and the skin test to the crude soybean extract was positive, the oral challenge phase of the study was initiated. On the second study day, the patients received the first oral challenge. The order of administration of the different types of oil was randomized by an independent third party, and capsules were administered while they were frozen to mask any distinctive flavors associated with the oils. The oil-containing capsules were administered in a sequential manner: first 2, then 5, then 8 ml of the oil (two, five, or eight capsules). Each challenge dose was followed by a 30-minute observation period. The challenge visits were at least 6 days apart. On the third, fourth, and fifth visits in the trial, the patients received the other oils, also in double-blind fashion. By the end of the fifth trial day, each patient had been challenged with all four types of oil. The patients were under the close supervision of medical personnel throughout the challenges. The trials with any patient would be terminated at the onset of any adverse reaction. None of the patients took any medications within 24 hours of the challenge. The study was approved by the Committee for the Protection of Human Subjects at the University of Wisconsin.

Results

IgE antibodies to soybean

All patients had an immediate wheal-and-flare skin test response to puncture tests with the crude whole soybean extract. Six subjects had elevated serum IgE antibody levels to soybean allergens by RAST; RAST was not performed on the seventh subject. The binding value to crude soybean extract ranged from 2.3 to 28.1 times that produced by pooled serum from six nonallergic individuals (Table II).

Table II. RAST results

Patient	% Binding of normal control serum pool*
1	230
2	1320
3	2730
4	NT†
5	320
6	2810
7	370

*Normal serum pool bound 0.3% of the total counts added.
†NT = Not tested

Oil challenges

None of these seven subjects experienced untoward reactions on challenge with any of the soybean oils or olive oil in quantities of 2, 5, or 8 ml. The patients were observed for 2 hours, and neither immediate nor delayed responses were observed to any of the oils. Although all patients had substantial histories of adverse reaction with the ingestion of soybean, none developed any of their typical symptoms or any other symptoms during the course of this challenge study. It is important to emphasize that the dose of soybean oil administered in the challenge is equivalent to the amount of oil that might be consumed during a meal.

Discussion

The ingestion of soybean oil did not provoke anaphylaxis in patients highly allergic to soybeans. The patients selected for study had strongly convincing histories of an immediate hypersensitivity reaction after the ingestion of soybean. We did not confirm the soybean sensitivity by an oral challenge because these patients had had multiple previous reactions and, in some cases, the anaphylaxis had been severe. Furthermore, the presence of immediate hypersensitivity to the soybean was confirmed by skin test and RAST assay. ln addition to the failure of soybean oil to elicit a response on oral challenge, all patients had negative skin test responses to the test oils. Thus, in a highly selected group of soybean-sensitive patients, there was no evidence for immediate hypersensitivity to the soybean oil by either skin test or oral challenge at doses totaling 15 ml. This dose is believed to represent a reasonable challenge since this amount of oil might be consumed in a meal. Thus, the results of the study should be relevant to practical usage levels of soybean oils.

Our findings are not surprising. In previous work we did not find an allergic reaction to peanut oil in peanut-sensitive patients. Like the peanut, the soybean is a member of the legume family. In the peanut the major allergen has been identified as a protein.[8] Similarly, the major allergenic fraction of the soybean is also proteinaceous,[4] and several fractions of soybean protein possess allergenic activity.[4] However, protein residues have not been detected in soybean oil,[5] making this an unlikely source of the soybean allergen. Our current observations are in agreement with these findings.

The soybean oils used in this study are representative of the types of oils sold in retail markets and used commercially in other products such as margarine and mayonnaise.

Therefore, these results should be valid for all soybean oil products with minor exceptions. If the soybean oil is used to fry food containing soybean protein, it is possible that the oil will then be contaminated with the soybean allergen. Subsequent use of the contaminated oil for frying other foods, whether or not they contain soybean, might be potentially hazardous to the soybean-sensitive individual. This, of course, is also true for other types of oil used in frying. Also, less purified types of soybean oil are available in a few markets, primarily in the health food sections. Although we did not detect any adverse reaction to the particular cold-pressed soybean oil (Hunza brand) used in this challenge, such oils may vary in their composition and may contain soybean protein. Therefore, we would advise soybean-sensitive patients to avoid cold-pressed soybean oil. Aside from certain special situations, however, soybean oil appears to be safe for the soybean-allergic individual.

The management of food hypersensitivity is largely by avoidance of the offending antigen. Overzealous restriction of an allergic patient's diet is not only unnecessary but also leads to confusion and undue anxiety. The results from this study indicate that the soybean-sensitive individual need not eliminate soybean oil from the diet.

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