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Food science perspective on food allergy

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Historical perspective

In recent years, food allergies and intolerances have attracted considerable attention from the food industry and governmental regulatory agencies around the world. Even among the medical community, food allergies have attracted increasing attention. Why the increased interest? Some have argued that the prevalence of food allergy, or at least severe food allergy, is increasing. Certainly, the increased knowledge of immunologic mechanisms and allergen chemistry has sparked some of this interest as well. But we wish to focus on the increased interest of the food industry and governmental regulatory agencies in food allergies. Until a decade ago, food allergies and intolerances were frequently benignly overlooked by the food industry and by governmental regulatory agencies.

Several reasons exist for the increased awareness of food allergies and intolerances in the food industry and governmental regulatory agencies. The discovery that sulfites could trigger asthmatic reactions in some sensitive subjects in the early 1980s captured considerable regulatory and food industry attention (1, 2). Sulfites were and still are among the most widely used food additives in the world, having many useful technological attributes that are valued by the food industry (3). The food industry became aware of the potentially serious reactions that could occur to otherwise innocuous ingredients among some sensitive consumers. The food industry curtailed sulfite usage, sought sulfite alternatives, and complied with new regulatory restrictions (3).

At least in the USA, the next major event was the publication of two papers describing deaths associated with food-allergic reactions (4, 5). For the first time, the food industry and governmental regulatory agencies recognized the potential severity of IgE-mediated food allergies. At the same time as the publication of these two papers, the press began to cover severe food-allergic reactions. Press coverage was particularly intense in Canada and the UK. Consumer groups representing the needs and concerns of food-allergic patients were also created in several countries. These groups worked to publicize the concerns of the food-allergic consumers. Simultaneously, at least one major food industry trade association became assertively involved in food allergies. After a severe food-allergic reaction at a party hosted by a Canadian food executive, the Food & Consumer Products Manufacturers of Canada developed an educational program for the food industry, including a remarkable videotape entitled *Allergy beware.* Through these events, the public, the media, the medical community, and the food industry have become more aware of the potential for allergic reactions, including severe allergic reactions arising from the inadvertent consumption by food-allergic individuals of their specific offending food.

Various governmental regulatory agencies have taken increased notice of food allergies as well. Because of the combined interest of consumers, the food industry, and the media, the Canadian government became the first in the world to begin to enforce food product recalls because of the unlabeled presence of allergenic foods in the product. Canadian labeling regulations require that packaged food products contain a list of ingredients that includes specific declaration of the vast majority of the components of that product. Thus, the Canadian government could enforce recalls when the ingredient list failed to declare the presence of an allergenic food that had caused an adverse reaction. Today, such recalls are frequent in Canada. Within a few years after the initiation of the Canadian regulatory actions, similar recalls

began to occur in the USA. Before 1990, there were only one or two (or often no) recalls each year associated with undeclared allergenic foods. In 1997, over 50 such recalls occurred in the USA, making food allergens one of the most common bases for food product recalls. Additionally, many of the recalls were class I recalls, which, in US Food and Drug Administration (FDA) parlance, means that the undeclared allergenic food posed a life-threatening risk to certain consumers. The publications by Yunginger et al. (4) and Sampson et al. (5) had increased the awareness by the FDA of potential life-threatening consequences from food-allergic reactions. Recalls are very expensive for the food industry because the affected company is required to retrieve the product from grocery shelves, distribution facilities, and even from consumer pantries through issuance of public news releases. Thus, especially in North America, food allergens have become a rapidly emerging, important, and expensive food safety issue.

Food-labeling regulations have also received increased attention with respect to the needs of food-allergic consumers. In 1995, the Food and Agriculture Organization hosted an expert consultation in Rome with the purpose of providing guidance on food allergy issues (6). The Codex Alimentarius Commission, which establishes guidance policies for labeling that are converted into regulations by most countries in the world, is continuing to consider modifications in its recommendations for the labeling of allergenic foods through the Codex Committee on Food Labeling. Codex is focusing on the identification of a list of commonly allergenic foods that would be the focus for increased labeling scrutiny. The foods and ingredients recommended for that list in 1995 were cow's milk, eggs, Crustacea, fish, peanuts and soybeans, tree nuts, sulfites, and wheat, rye, barley, and related grains (6). Some debate has occurred regarding which foods should be included on this list.

Food industry situation

Experience in the USA and Canada where comprehensive labeling regulations already exist suggests that hazardous situations will continue to occur even with more universal adoption of such regulatory policies. Several errors can occur in the food-processing industry that can result in the presence of potentially hazardous levels of allergenic foods in products that are not declared on the label. Some of these errors are obvious such as mix-ups in packaging and formulation mistakes. Other food industry practices are less commonly recognized by the medical community.

The food industry often uses the same equipment to process more than one type of food product. Examples would include egg-containing and egg-free pasta, ice cream and sorbet, and peanut and peanut-free chocolate products. If food processors fail to clean shared equipment adequately between processing of a product that contains a commonly allergenic ingredient and a product that does not contain any ingredients from that same allergenic source, potentially hazardous residues of the allergenic food can contaminate the supposedly allergen-free product. Several such instances have been investigated, including milk contamination of sorbet (7), milk contamination of a soybean-based frozen dessert (8), peanut contamination of sunflower butter (9), walnut contamination of oatmeal raisin cookies (10), and hazelnut contamination of a chocolate confectionery product (11). Currently, the food industry does not have access to specific analytic methods to detect contamination by unlabeled allergenic foods. The development of specific immunoassays for such purposes holds considerable promise (12). With such tests, the food industry would have the ability to determine the adequacy of its cleaning procedures on shared equipment.

The food industry also frequently uses rework. "Rework" is the food industry's term for leftovers. Defective products are mixed into the formulation for a new batch of product. If the company uses a "like-into-like" policy for rework, then allergen contamination is unlikely to occur. Severe reactions may occur from questionable rework practices (13).

The food industry is becoming more aware of food allergies. Some companies have developed rather sophisticated approaches intended to eliminate undeclared food allergens from their packaged products. However, considerable education is still required of the food industry to increase awareness in all companies, large and small, of the problems associated with unlabeled residues of allergenic foods. Food companies should be encouraged to validate the effectiveness of their cleaning procedures for shared equipment by newly available immunoassay methods and to develop "like-into-like" policies for rework.

Risk assessment for food allergens

Regulatory policies must be established on the basis of comparative risk. Any risk assessment of the hazard posed by allergenic foods requires a determination of the size of the population at risk, the severity of the risk, and the tolerance of the population of the offending food. Unfortunately, current clinical information is insufficient to allow a precise assessment of the risk associated with any particular foods.

The overall prevalence of IgE-mediated food allergies is thought to be in the range of 1–2% (14, 15). The prevalence of allergies to specific foods is largely unknown, with the possible exception of cow's milk allergy, which appears to affect approximately 2% of young infants (16). Recently, Hill et al. (17) have accumulated some interesting information on the comparative prevalence of various types of food allergy in Australia, but more such information is needed for risk assessment.

The prevalence of severe food allergies is also poorly understood. Certainly, the inadvertent ingestion of allergenic foods has resulted in deaths (4, 5). Fatal reactions seem to occur more commonly to peanuts, tree nuts, and Crustacea than to other commonly allergenic foods. By extrapolating from a 2-year study of admissions to 73 Colorado (USA) emergency departments, Bock (18) estimated that 950 severe reactions to foods occur annually in the USA, an incidence rate of 0.0004% based upon a US population of 250 million. Certainly, more information of this type should be collected to add urgency to the regulatory decisions being considered around the world.

Finally, individuals with IgE-mediated food allergies can react adversely to the ingestion of extremely low levels of the offending food. However, very few attempts have been made to define precisely the dose-response relationship for allergenic foods. Recently, Hourihane et al. (19) conducted double-blind, placebo-controlled food challenges in a dozen peanut-allergic individuals and found that the threshold dose for objective symptoms ranged from 2 to >50 mg. More data are needed to allow more precise definition of the dose-response relationship for allergenic foods for peanuts and other commonly allergenic foods.

Conclusions

Certainly, more data are needed on the prevalence and severity of food allergies to provide the stimulus for regulatory decision-making that would benefit food-allergic consumers. The food industry also requires better analytic tools so that it can ensure that manufacturing practices are adequate to prevent contamination by allergenic foods.

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