

Resource 2: Implications of food allergens and a safe food supply

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Introduction

Food allergy is a serious public and personal health concern that affects approximately 10-12 million individuals. The serious nature of food allergies is amplified by about 30,000 anaphylactic episodes annually, and their contribution to 150 anaphylactic-related deaths per year. Recent survey data indicate nearly 4% of children under the age of 18 years reported an allergy to at least one food item. This statistic increases to 6-8% of children less than six years of age, and is comparable to that of adults.

Six common foods account for nearly 90% of the food allergy reactions. Those foods are milk, eggs, peanuts, tree nuts (Almond, Cashew, Brazil nut, Pistachio, Macadamia, Walnut, Pecan, Hazelnut, Pine nut), fish, and crustacean shellfish. According to the Food Allergen Labeling and Consumer Protection Act of 2004, these foods plus two others, namely soybeans and wheat, are now required to be declared on food labels, if the product contains or was produced in a facility that may contain any of these basic eight foods.

The serious nature of food allergy reactions and the increasing prevalence of food allergies across the population spectrum provided a public health foundation for the current Dietary Guidelines Advisory Committee to assess the food safety implications of food allergens, to recommend to the government that they take further action to educate the general consumer on the topic, as well as providing guidance to sensitive individuals on reducing exposure to food allergens.

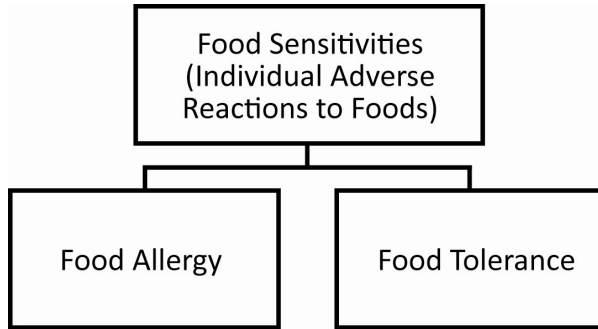
Background

Before addressing some essential and often complex food allergy-related questions, it is important to facilitate a basic understanding of food allergies. Fundamentally, there are two types of food sensitivities or adverse reactions associated with exposures to food allergens. Those types involve the consumption of the triggering component(s) or inhalation of the causative agent(s). Sensitive individuals may present overt food allergy symptoms, or present symptoms associated with

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food intolerance. A diagram depicting this adverse food reaction divergence among these individuals is shown below in Figure 1.

Figure 1. Food Sensitivities



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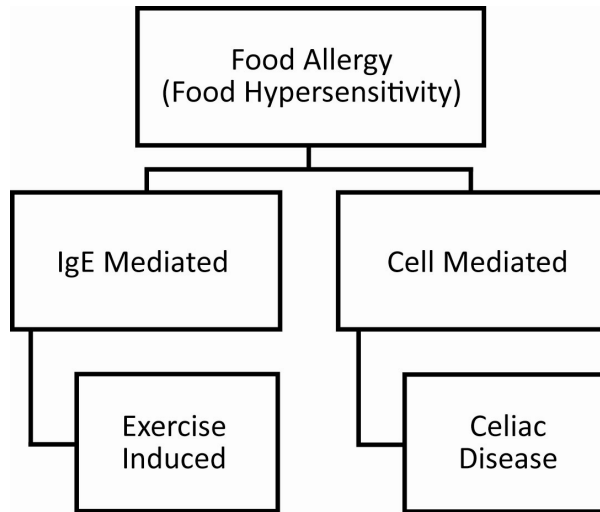
According to the National Institute of Allergy and Infectious Diseases, the human body's adverse response to food can be caused by several by two fundamental mechanisms. Those mechanisms either involve the immune system or numerous systems outside of the immune system, typically the digestive system. The latter is often referred to as food intolerance. A classic example of food intolerance is lactose, a natural sugar found in breast milk and other mammalian milk products, including cheese, yogurt, and kefir. Other possible food intolerances perceived by consumers and may be clinically identified include strawberries, mushrooms, chocolate and raspberries. Yet, many individuals can present food allergy symptoms with these same foods.

Food allergens, usually proteins, occur naturally in all foods whether raw, semi-processed or processed. In sensitive individuals, exposure to these food proteins stimulates certain kinds of cells that result in specific immunologic reactions.

As suggested in Figure 2, there are many components involved in frank food allergy. A food allergy reaction may be mediated by IgE antibodies, a specific type of immunoglobulin made in response to offending proteins, or not mediated by IgE but rather through specific kinds of cells.

Food-dependent allergic symptoms and even anaphylaxis may also present during or immediately following exercise (Beaudouin, 2006). While this occurs infrequently, several of the common allergenic foods are considered the offending culprits. The most notable of these foods are wheat flour, crustaceans and soybeans (Adachi, 2009). Once again, avoidance of known and potentially offending foods is essential if individuals are to reduce the risk of exercise-induced food allergy reactions.

Figure 2. Food Allergy

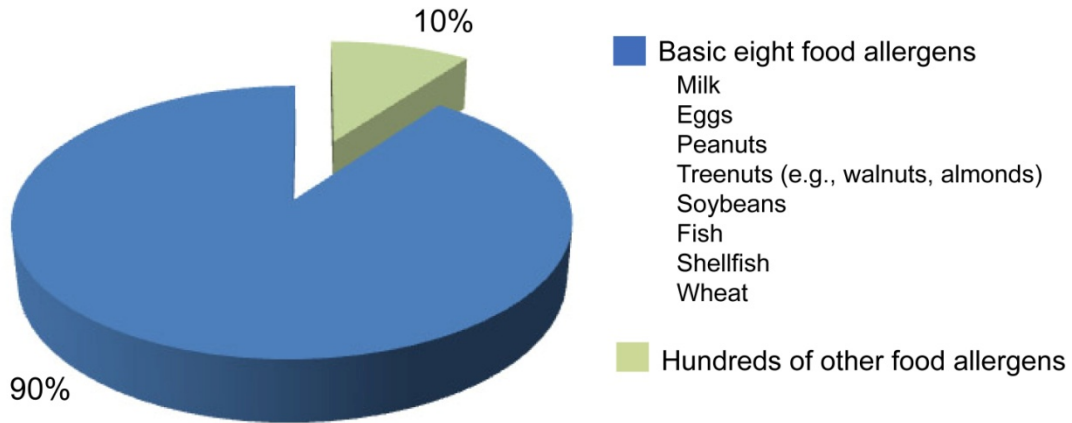


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In addition to the basic eight allergenic foods, estimates suggest that the wide variation in food allergenicity also includes 0.1% to 4.3% for fruits and tree nuts, 0.1% to 1.4% for vegetables, and less than 1% for wheat, soy, and sesame (see Figure 3). Allergenic reactions to these foods are more common among adults than children. Allergy to food additives and preservatives, such as Yellow #5 (tartrazine), monosodium glutamate and sulfites is quite uncommon. Similar reactions to natural food substances, including colorants and spices like annatto, carmine, and saffron, are rare. However, the serious medical management of adverse events associated the exposure to and consumption of these food ingredients cannot be underestimated (Chapman, 2006).

There are many factors that contribute to IgE-mediated food allergy. Those factors include individual genetics, exposure to allergenic food, an individual's age at initial exposure, the dose, frequency, and duration of exposure, and the immunogenicity of the food. Recent IgE antibody survey data indicate individuals (> 18 years of age) classified as non-Hispanic black and Hispanic are at greater risk of adverse reaction from peanuts, eggs, milk, and shrimp, than their non-Hispanic white counterparts (Branum, 2009). Regardless of these factors, the associated broad-range of symptoms of IgE-mediated reactions to foods affecting the gastrointestinal tract, skin (cutaneous), and respiratory tract can contribute to a life-threatening reaction known as anaphylactic shock. This generalized, systemic reaction can produce multiple organ failure, a significant loss in blood pressure and heart beat irregularities. Anaphylactic reactions in response to food allergen exposure account for 33-52% of emergency room visits. The majority of these visits is among teens, who often consume offending foods with peer groups despite the inherent adverse reactions.

Figure 3. Food Allergies Prevalence

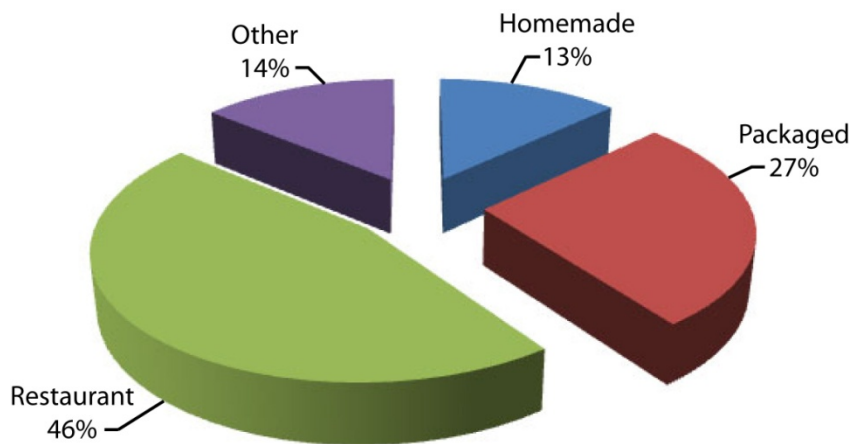


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Implications:

Restaurants: Allergenic foods are most frequently associated with restaurant menu items prepared without adequate separation from known allergenic foods and without appropriate product labeling (see Figure 4) (Ahuja, 2007). Therefore, it is incumbent upon sensitive individuals to adhere to strict avoidance of offending foods, relentlessly ask questions concerning food preparation and composition, and read product labels. Ultimately, these individuals must be prepared to manage an adverse reaction, especially in the potential of food-induced anaphylaxis.

Figure 4. Source of Food Fatalities



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There are two other critical and necessary actions that can reduce the exposure of allergenic foods in restaurant settings. Those two actions for restaurants include a written plan in the event of a food allergic reaction by a patron, and a plan to assure “allergen” safe meals. Each of these action items requires additional training of all kitchen and wait staff, and additional precautionary efforts by consumers. These important changes in restaurant settings are currently voluntary. Under current nutrition labeling regulations, restaurants are exempt unless a health claim, such as low fat or low sodium is stated. However, many cities across the country have advocated a federal nutrition labeling requirement, a position also supported by the restaurant industry if the requirement were uniform.

Packaged Foods: Effective January 2006, all commercially produced foods must include an allergy statement if the product contains one of the basic eight sources of food allergens or the product was produced in a facility that may contain or have contained one of these food allergen sources. There are several food ingredients that are exempt of food allergen labeling. Those ingredients include refined oils, even if they are derived from one of the basic eight food allergen source, and commodities, such as fruits and vegetables. While these oils may contain virtually negligible traces of allergenic proteins, a recent report suggests that these trace amounts may be sufficient to trigger an allergic response in some individuals with a very low threshold of a reactive dose of allergenic protein (Ramazzotti, 2008). In addition, some cold-pressed oils, while providing more flavor, may actually contain allergenic proteins (Hoffman, 1994).

In addition, there is a regulatory process whereby a food supplier can petition the FDA for an exemption if the company provides sufficient evidence that the food or ingredient is free of known allergens. An inventory of those ingredients is available at the following websites:
<http://www.fda.gov/Food/LabelingNutrition/FoodAllergensLabeling/ExemptionsfromFoodAllergenLabelingPetitionNotificationProcess/ucm076656.htm> and
<http://www.fda.gov/Food/LabelingNutrition/FoodAllergensLabeling/ExemptionsfromFoodAllergenLabelingPetitionNotificationProcess/ucm076631.htm>

Schools, Day Cares and Camps: School lunchroom, day care centers and summer camps represent venues of unexpected exposure to food allergens and new challenges for parents of young children and program administrators. Among those challenges are indoor allergens.

Interestingly, some allergen exposures in school and day care environments are greater than those in the home. Many of aeroallergen exposures include cat and dog allergens, even in the absence of these companion animals, dust mite allergens, cockroach and rodent allergens, and fungal allergens (Salo, 2009). These risk factors may augment adverse respiratory reactions among susceptible individuals, including those where asthma and food allergy are chronic conditions. As a result, many schools and centers with a high density of children have discouraged pet contact before

attendance, and have modified facilities, including shelving and ventilation, in order to improve control of allergens in the classroom.

Although the U.S. now has mandatory food allergen labeling and declaration, the risk remains high for accidental exposure to food allergens in a co-mingled atmosphere of young children (Sheth, 2010). This issue, heightened by the 2007 Newsweek (November 5, 2007) article on allergies in the lunchroom, appears to lack adequate studies that assess the risks of food allergen exposure in environments dominated by young children. Nearly a decade ago, several medical organizations and health care professions, in collaboration with parents and schools developed guidelines to assist schools to reduce the risk of accidental food allergen exposure and establish response strategies to manage unintended exposures (Sheetz, 2004; Young, 2009). Collaborative efforts by the National Association of School Nurses, The Food Allergy & Anaphylaxis Network, the National Association of Secondary School Principals, National School Boards Association, and the American School Food Service Association lead to the development of an important document that outlined school guidelines for managing students with food allergies (<http://www.foodallergy.org/school/guidelines/SchoolGuidelines.pdf>). Members of these organizations presented specific areas of responsibility for families, schools, and students in an effort to minimize food allergen exposure risks and to provide a safe educational environment for food-allergic students. Central to these guidelines is educating children on the management of their food allergy, working with school administration and teachers on policies and prevention plans that address food allergy management, and providing a proactive “no trading food” stance among students.

In addition to these excellent guidelines, several communities and states have established regulations and laws requiring implementation of plans to educate students about food allergies and development of plans that provide medical management, risk reduction, and communication and implementation that are uniform among schools across the country. For example, in 2004 the New Jersey Legislature passed a resolution which urges school districts to acquaint personnel with the dangers of peanut allergy and to establish peanut-free cafeteria areas. Subsequently, New Jersey launched a “Ask Before You Eat” campaign designed to inform the public about food allergies and anaphylaxis (<http://www.state.nj.us/health/chs/monthlyfactsheets/foodallergy.pdf>). Similar initiatives were adopted in Michigan, Connecticut, Massachusetts, Tennessee, Vermont and California. An in-service training program for school staff, camps, and daycare centers regarding food allergy safety is now available through Safe@School™ Partners Inc. (www.foodallergysmart.org). In addition, the USDA has numerous educational materials and resources available that inform the public regarding food allergies and food intolerances (<http://www.nal.usda.gov/fnic/pubs/bibs/gen/allergy.pdf>).

Home Environment: Some of the variables that impact the potential of food allergies in the home are genetic background, local environment, and time of exposure. Since the immune system in infants and children is not fully developed, these populations have a greater risk of developing food allergic disease than adults (Rona, 2007). Thus, one would expect children of parents with at least one food allergy are at greater risk of developing a food allergy. However, the American Academic of Pediatrics recently noted the absence of conclusive evidence that even among women with food allergies that dietary restrictions during pregnancy may reduce the risk or delay the onset of food allergy in their infants (Thygarajan, 2008).

The home and its environment typically represent children’s first exposure to common allergenic foods (Vlieg-Boestra, 2008). Thus, the fundamental principle of reducing the risk of food allergy begins in the home. The American Academy of Pediatrics has an informative brochure on managing food allergies among children (www.aap.org). The principle goal in the food allergy home of growing children is to eliminate exposure to the offending foods while providing adequate nutrition for optimal growth and development. Even among adults, avoidance of food allergens can contribute to dietary insufficiencies and possibly excessive weight loss (Kershaw, 2009). In general, avoidance advice should include several principles as shown in Table 1 (Venter, 2010).

Table 1. Food Avoidance Principles

- Prevent cross-contamination: thoroughly wash food contact surfaces, (cutting boards, utensils) and hands
- Ask preparation questions, especially if eating away from home
- Read and understand food labels
- Contact food manufacturers, if uncertain; undeclared processing aids and “may contain” statements could require greater clarification

Source: Venter, 2010

Child or adult, it is critical to assess the level of food allergen avoidance as well as the type of food hypersensitivity (see Figure 2). This assessment should be determined in collaboration with a professional allergist.

Oral Tolerance: The concept of oral tolerance has gained attention in the medical and scientific community. Recent evidence suggests the onset of food allergy may reflect intolerance to dietary or foreign proteins. An important barrier to foreign proteins is the gastrointestinal (GI) tract. The GI tract not only represents a large surface area through which we absorb nutrients provided through

foods, it is a significant component of the immune system. If this immune system is compromised or immature, there is an increased risk for food allergy development. For example, while about 2% of ingested food allergens are absorbed and transported without modification in the mature gut, the GI tract among susceptible individuals may have an increased permeability or leakiness and altered intestinal bacteria profile. These changes may occur following the administration of some antibiotics, thereby increasing their risk of food sensitization and enhanced severity of food-induced allergic reactions (Groschwitz, 2009).

A novel approach in treating food allergy is through the induction of oral tolerance. Limited research suggests early introduction of allergenic proteins, such as those in peanuts, may actually reduce the risk of allergy (Du Toit, 2008). In this case, it appears that in some susceptible individuals, high level of exposure to peanuts, such as through peanut butter in the home, may promote sensitization, whereas low level exposure may be protective (Fox, 2009). These kinds of observations relative to the development of food allergy and the timing of complementary foods are inconsistent and controversial. On the side of caution, the American Academy of Pediatrics' consensus statement is that there is insufficient evidence to support early intervention (4-6 mo. of age) with complementary foods as protective against the onset of food allergy (Greer, 2008).

Other Food Allergens: Approximately 10% of food allergens are not limited to cow's milk, egg, crustaceans, fish, peanut, soybean, tree nuts, and wheat. Many sensitive individuals experience cross-reactivity among multiple foods. For example, an individual allergic to birch tree pollen may experience allergy symptoms when exposed to peach, apple, celery, carrots or cherries and related fruits (Asero, 2004; Matthes, 2009; Bollen, 2007; Marković-Housley, 2009; Fuchs, 2006). Some of the claimed immunomodulatory effects of garlic, a member of the same family of onions, shallots and leeks, contains alliin lyase, which appears to be cross reactive and sufficiently allergenic to trigger allergic reactions among those sensitive to members of the Allium family (Kao, 2004).

Food Processing: The impact of food processing, such as the use of food enzymes and heat to hydrolyze or breakdown allergenic proteins requires additional research. There is limited evidence that food grade enzymes may reduce the allergenicity of some milk proteins, such as β -lactoglobulin in the whey fraction, and may reduce the phytate content of grains. In addition, some heat treatments, intended to assure food safety, may denature allergenic proteins, such as those in some vegetables (Mills, 2008). A recent evaluation of food processing on the impact on allergenic properties of food allergens indicates there is a dearth of scientific research on this topic, which, in part, reflects the complex nature of a food matrix and the individuality of allergenic response to these food components (Mills, 2009). This issue is further complicated by our naive understanding of cross reactivity of allergenic proteins, and that many of these proteins are naturally found in an array of foods. For example, some proteins found in egg whites are abundant and distributed in

edible nuts and seeds, such as soya beans. Another complication is that while some proteins are partially denatured during various processing environments, other proteins are resistant to structural modifications and potential reduction in allergenicity. Again, some of the soybean-derived protein fractions are slow to change allergenic properties during exposure to an elevated heat environment and even during an extensive mixing or shear process (Mills, 2003). It is important to note that several plant-derived proteins present similar structural characteristics and possibility of allergenicity as those found in some animal proteins. Some of these proteins are also thermally stable and resistant to hydrolysis (Breiteneder, 2005; Sathe, 2009).

Some methods of food processing may increase the allergenicity of foods (Sathe, 2009) although evidence is mixed. For example, whereas some research suggests that peanut roasting may not alter the allergenicity of peanut proteins (Mondoulet, 2005), other studies indicate that the roasting and possibly the maturity of the peanut may increase the presence of antibody binding epitopes, or those protein segments responsible for an allergic reaction (Pomés, 2006).

The National Institute of Allergy and Infectious Disease will publish an update for “Guidelines for the Diagnosis and Management of Food Allergy” in 2010. While this publication is directed to health care professionals, the concepts of identifying and managing food intolerance and food allergy are well-presented and should be useful for those interested in these important areas (<http://www3.niaid.nih.gov/topics/foodAllergy/clinical/>).

Consumers should continue to carefully read food product labels which provides information on the basic eight food allergens. Individuals diagnosed with food allergies beyond these basic eight are urged to read food product label ingredient declaration statements that should include all product components, including those that may contain potential allergens. At this time, the food ingredient declaration statements are not required to include processing aids. These are similar to excipients included in some medications, yet are not bioactive or included in the ingredient statement. Thus, it is critical that consumers with diagnosed food allergies contact food producers for additional information. This information should be readily available through the customer service contact information.

Additional Resources:

For further information on food allergens, the reader is encouraged to access the Allergy Resource List from USDA's Food and Nutrition Information Center (Beltsville, MD) via <http://www.nal.usda.gov/fnic/pubs/bibs/gen/allergy.pdf>.

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