Food Allergy — How Much of a Problem Really is This in India?

S V Gangal and B K Malik*

Center of Biochemical Technology (CSIR), Mall Road, Delhi 110 007

Food allergy is estimated to affect 1-2 per cent of the whole population, however its prevalence in children is quite high. Food hypersensitivity is an immunological reaction resulting from the ingestion of a food. This reaction occurs only in some patients when only a minute quantity of the substance is ingested. The reaction could be mild, moderate or severe leading to anaphylaxis and sudden death. IgE mediated reactions account for most of the well-characterized food allergic reactions although non-IgE mediated immune response is also seen occasionally. Although there has been a great concern in western countries about food allergies, in India the prevalence of food allergy although preserved has not been systematically studied. Unfortunately there is not much awareness about food hypersensitivity reaction in India. Indian food is quite complex and it is necessary for a high risk person to know what kind of food he is allergic to. Diagnosis of food allergy is quite lengthy procedure and many times it is not possible to avoid the offending food. There has been a great concern in many countries including India about the adverse reaction to foods. However because of lack of data in food allergy in India it is quite difficult to evaluate the allergenicity of GM food.

Keywords: Food allergy, Allergy, Food packaging industry

Currently the food safety issue has gained much importance due to growth of food processing and ready made food packaging industries. In addition to toxic effects of certain foods, many produce adverse reaction in some individuals. Adverse food reactions can be defined as abnormal responses to an ingested food. The abnormal food reaction could be either due to food hypersensitivity, (food allergy) or food intolerance.

During the last decade food allergies have attracted considerable attention from the industry and government regulatory authorities. Recently Indian government has planned to boost food packaging industry, therefore, it is all the more relevant to know about foods causing allergic reactions.

Food allergy is an immunological reaction suffered by some individuals resulting from the consumption of certain foods and it involves IgE antibody, responsible for a wide range of anaphylactic reactions. Foods that induce excessive IgE synthesis are called allergens. The specific IgE antibodies are produced by some atopic individuals against certain allergens in food which bind to mast cells or basophils. A second exposure of such allergens results in binding of the allergen with the IgE on these cells leading to their degranulation and release of certain mediators which cause various allergic reactions such as, diarrhoea, asthma, rhinitis, urticaria, and eczema, or, even severe systemic reactions leading to death. Food intolerance is described as an abnormal physiologic response to some ingested foods and is not immunologic but mainly caused by anaphylactoid reactions, metabolic disorders and idiosyncratic responses, They are not typically caused by food proteins but by many other molecules.

The IgE mediated hypersensitivity to foods causing allergic reactions such as asthma, rhinitis, atopic dermatitis, urticaria, oral symptoms such as swelling of lips and tongue, gastrointestinal disturbances or even anaphylaxis of varying degree are quite common. In this, the tolerance level of food proteins is extremely low. Although common man perceives allergic reactions after consuming different types of foods to be quite high, very few significant data is published to address this issue in India. Internationally 1-2 per cent of adult population is reported to be affected by true food allergy and its prevalence is higher in children, about 6-8 per cent.

* Corresponding author
email: bkmalik@cbt.res.in
The risk of suffering an allergic reaction depends on the degree of sensitivity of an individual to the allergens, the potency of the allergen, and the quantity or dose of the allergen consumed. These allergens could be identified and require careful tracking during food manufacture. Since food allergy involves abnormal responses to proteins, food allergy is of great concern to biotechnologists developing genetically modified foods.

The first report of adverse reaction to foods such as milk was recorded 2000 y ago by Hyppocrates. In India, the traditional systems of medicine describes many foods as causing pitta vata or cough and are forbidden in some disease conditions or in some seasons.

Our understanding of food allergy has made tremendous strides recently. The major advance in our knowledge of food allergy emerged in 1921 when Pranstsitz and Kustner demonstrated that a substance in the serum of Kustner was responsible for the allergic reaction to fish and the reaction could be transferred to another individual. It was demonstrated that injection of small amount of Kustner’s serum (who was highly sensitive to fish) into the skin of Prausnitz (who was not sensitive to fish) forearm, a wheal and flare would develop after the ingestion of fish by him. Attention towards food allergic reactions increased when Youninger et al. and Sampson et al. published reports describing deaths associated with food allergic reactions. In the US, total country networks of patients sensitive to peanut have been formed and are given full information on prevention of allergies. In western countries government regulatory agencies recognized the potential danger of IgE mediated food allergens and the public, medical community and media have become quite aware of potential anaphylactic allergic reactions in some individuals arising from inadvertent consumption of the specific offending food. In India due to unknown reasons the incidence of food allergy is very small compared to that in western countries. The general public is not aware of the importance of food sensitiveness in triggering allergic manifestations such as atop dermatitis, rhinitis or asthma. Hence food allergy remains undiagnosed in India. In recent years, however the incidence of allergic sensitization is increasing rapidly.

Several studies worldwide have shown that prevalence of true food allergy particularly in young children is quite significant. The most common foods identified as allergic to many people in western world or consumed world wide are egg, milk, peanuts, and other dry fruits (almonds, pista, chis) soybean, legumes, sea foods, some fruits etc. accounting for over 80 per cent of the food allergies reported. Food allergies are the single most common cause of generalized anaphylaxis in hospital emergency department accounting for about one third of the cases in western countries. It is established that about 100 total cases of food induced fatal anaphylaxis occur in USA each year. There is a person to person variation in threshold for the offending foods. But the most sensitive food allergic individuals will experience reactions from exposure to minute quantities of the offending food.

It is very difficult to identify a particular protein as allergenic as these proteins do not show any special characteristics on analysis. No particular secondary or tertiary structure can be described as being solely and intrinsically allergenic. No tests such as, analysis of structure function and physio-chemical properties or animal models are available to evaluate or predict allergenicity of a protein in an objective manner. However most of the allergenic proteins have protease type of activity. However, some tools are proposed to predict the inherent allergenicity of proteins. Stability hypothesis states that food allergens must exhibit sufficient gastric stability to reach the intestinal mucosa for absorption and sensitization to occur.

In India, food allergy is yet not recognized as a major problem since food allergies are considered as more easily avoidable. Medical community is aware to some extent about the complaints of patients giving history of adverse reaction to pulses such as, black gram, Cajon pea, french bean, horse gram, lentil, musterred, reddish, some fruits, milk. However systematic reports are not available showing prevalence of food allergies or the important food allergens in Indian population established by double blind placebo controlled food protection tests. A couple of reports are available describing allergic manifestation such as pruritis, viriticas, angioedema, gastroenteritis, respiratory allergic symptoms on consumption of certain common foods in allergic patients. Many foods such as peanut — reported to be causing major public health problem in the US — has not been of much consequence in India. Very
Mechanism of Food Allergy

True food allergy is an immunological reaction resulting from the ingestion of food or food additive. It can occur in some patients after only a small amount of the substance is ingested. The mucosal barrier of immune system of gastrointestinal tract prevents allergic reactions to foods. Nonimmunologic and immunologic mechanism operate to block foreign antigens from entering body. The mucosal barrier function is reduced if these mechanisms are immature in some infants. Intestinal secretions contain secretary IgA antibodies. In the gut lumen antigen sp. IgA blocks the absorption of foreign antigens to expose them for proteolytic digestion. The processing of food antigens by the gut is essential for development of oral tolerance. Exclusive breastfeeding for 6 months has been reported to promote oral tolerance and prevent food allergy. Recent studies indicate that initial sensitization of T-cells against allergens takes place in utero by means of transplacental transport of allergens to which the mother is exposed during pregnancy. After birth, during infancy and early childhood, high level exposure to dietary allergens leads to T-cell allergy. Failure of these allergen driven immune deviations during early life seems to be responsible for development of allergic responses to ingested food or other allergens which continue during adulthood, especially in genetically predisposed children. While other children although may show an allergic response to certain foods such as milk or eggs usually come out of it within the first 1 or 2 y. The development of tolerance is a dynamic process and it commences in the childhood and remains active during adulthood. There is substantial evidence that antigen processing by GALT is crucial for tolerance induction. Sometimes food allergy could be due to cross reactivity of some food allergens to pollen allergens in pollen sensitive patients.

Diagnosis of Food Allergy

Diagnosis of food allergy is a complicated process. While allergic reactions to food are mostly IgE-mediated reactions, several immune mechanisms may contribute to adverse reactions to foods that have an immunological basis. Cross-reactions with pollen allergens and profilin, make the identification of true food allergy difficult. New allergens may be evolved during processing or cooking of food. The presence of food specific IgE in serum or a positive skin prick
Methods used in diagnosis of food allergy for many reasons (Table 1).

The diagnosis of food allergy requires very careful recording of the history of patients’ symptoms and food habits, selective skin prick/intradermal test, which could be confirmed by RAST. Skin prick test is often used to diagnose patients with suspected IgE food allergies. A positive skin test to a food indicates the possibility that the subject has symptomatic reactivity to that specific food, however, this needs to be confirmed using RAST or DBPCFC. A negative skin test more or less confirms the absence of IgE-mediated allergy to that food. However, in order to get satisfactory results with skin tests the extracts need to be fresh and standardized, as some of the allergic components of food are highly labile. Infants may have IgE-mediated food allergy in the absence of positive skin test. The DBPCFC has been considered the standard test for diagnosis of food allergy. Presently, commercially available food allergen extracts are not standardized and their stability is also not well defined.

The criteria of positive diagnosis by DBPCFC should be assessed by objective measures such as FEV1 (forced expiratory volume) and symptom score. For eczema, scoring systems are of proven value (Table 2).

Most of the patients of food allergy present not only skin manifestations but also accompanying rhinitis and asthma.

Fruits and Vegetables

The recent recognition that oral allergy syndrome to fresh fruits and vegetables affects some 4 per cent of the subjects suffering from pollinosis indicates the importance of fruits and vegetables in inducing allergic reactions in adults. Recent data reveal that vegetable foods are the most common causes of food allergies independent of pollinosis in adults, although not much data is available in India on the subject, a few studies have demonstrated cross-reactivities of grapes, apple, peas and peach with some pollen allergens such as, artemesia and birch.

Recently patients showing sensitivity to latex allergen were also found to be allergic to banana, melon, avocado etc. Papaya, a commonly consumed food, has been shown to cause allergic reactions in a few patients. The enzyme papain from papaya which is used as a tenderizer for meat is the major allergen. This can cause allergic reactions in sensitive patients on consumption of such tenderized meat. IgE-directed against papain can cross-react with other proteases such as bromalin from pineapple. Active papain and not the inactive papain elicited rise in IgE antibodies. Allergen from oranges, cherry, banana, papaya and avocado and sapota have been identified and some of them have been characterized.

Patients allergic to grass pollens are reported to be allergic to Rosaceae fruits such as apple, peas and peach. A few allergens specific to fruits such as peach and kiwi, sapota (Achras zapota) have also been reported. An unusual case of anaphylaxis to mannitol arising out of ingestion of pomegranate fruit has been reported from Mysore.

Recent reports indicate that only a few cross-reacting allergens are responsible for the symptoms caused by a large series of vegetable foods in subjects with pollinosis, defined as pan allergens. Many of these allergens belong to a family of proteins involved in defence against pathogens or in fertilization of plants or structural proteins such as profilins. Major allergens from birch pollen Bet V2, apple Mal A2 and celery Apig are profilins. It seems that profilins are very efficient in sensitizing but less efficient in inducing clinical symptoms.

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<th>Table 2 — Symptoms of food allergy syndrome</th>
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Table 1— Methods used in diagnosis of food allergy

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<td>Skin prick test</td>
<td>Medical history</td>
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<td>Double blind placebo</td>
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<td>Controlled food challenge</td>
<td>Radioallergo sorbent test</td>
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<td>Elimination diet</td>
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Under the vegetables group parsley, carrot, bell pepper, and potato allergens have been characterized and have shown cross-reactivities with pollen of distinct species. Data on indigenous fruits and vegetables allergy is not yet available in India. A few reports on oral reactions immediately after consumption of fruits such as apples, oranges, grapes and sapota are published\(^22\).

**Milk and Milk Products**

Cow or buffalo milk is among the first foods introduced to infants in most parts of the world and is one of the most common causes of food allergy in young children. It may be noted that lactose intolerance is different from true milk allergy. Most of the studies reported on cow milk from several western countries and Australia have shown that 2.5 per cent of neonates experience hypersensitivity reactions to cow’s milk in the first year of life\(^23\). Both IgE and non IgE mediated reactions account for half of the milk allergy disorders each. The children whose symptoms were not mediated through IgE normally come out of their sensitivity by the third year of their life. It has been reported that 15 per cent of infants with IgE mediated milk allergy retain their sensitivity and may develop allergic reactions to some other foods\(^23\).

Milk is consumed as fluid, cheese or curds etc and commonly used in various sweets in India. Traces of milk or milk proteins mixed with other foods in the diet can cause anaphylactic reactions in milk sensitive children. Milk induced eczema is the first sign of allergy in children.

Casein, lactalbumin and lactoglobulin are the major allergic proteins of milk and they have been characterized\(^24\). Although allergy to buffalo milk which is consumed in this part of the world is not investigated properly, the cross reactivity between proteins in cow, goat, and sheep has been reported. Casein which constitutes 80 per cent of milk proteins is the most allergenic milk protein\(^25\).

There are reports that a low IgA content in human milk may lead to defective exclusion of milk antigens and thus predispose an offspring to develop food allergies\(^26\).

**Eggs and Egg Products**

Chicken egg is one of the most common causes of food allergic reactions in children and even in adults. Egg allergy has been diagnosed in many children and adults in India. The egg yolk is considered less allergic than the white portion. However, livetin from egg yolk has been implicated in causing allergic symptoms. Ovomucoid (Gal d\(_1\)), Ovalbumin (Gal d\(_2\)), Ovotransferin and lysozyme have been identified as major allergens in eggs\(^27\). Ovomucoid has been identified as a common allergenic protein. Sun dried or vacuum dried egg white powder has been used in many food preparations including icecreams and such foods are therefore necessary to be avoided by egg allergic patients to avoid any anaphylactic reaction. Wheezing, tightness in the chest, cough, rash and gastrointestinal symptoms, and cramps, have been reported in patients shortly after eating eggs.

**Legumes**

In western countries especially in the US allergic reactions to peanut and soybeans are amongst the most common in children and adults. Many persons suffer severe anaphylactic reactions due to the inadvertent consumption of peanuts in some form\(^28\). Legumes are important source of protein in vegetarian diet in India. The pulses such as black gram, cajan pea, french bean, horse gram, green gram and lentils from Leguminosae family are used commonly in Indian diet. Green peas, navy beans, dals such as lentils, urad, and gram have shown mild or severe anaphylactic reactions in many atopic patients\(^6\). Very severe anaphylactic reactions have been reported due to the consumption of gram by sensitive subjects. Most of these subjects have shown severe gastric or asthmatic symptoms. Dermal reactions have also been reported in some patients. Peanut, soybean and dal\(^11\) allergic proteins have been well characterized. Sixteen allergic fractions have been identified in raw peanuts by CRIE and 8-10 in Bengal gram. Stored peanuts can also contain aflatoxins which can be highly toxic and known to be carcinogenic. In peanuts 32 protein bands have been identified on SDS-PAGE with molecular weights of 14-64 kda, out of which Arah 1, Arah 2 and Arah 3 have been identified as major allergens\(^32\). However peanut allergy is not common in India.

Soybeans are used in many countries including India because of their high protein content, DBPCFC studies have demonstrated that soybean can cause allergic reactions. Even pressed oil from soybean and
peanuts were found to retain some of their allergenic potential but refined oils were safe. More recently soybean has been identified also as an occupational allergen inducing asthma. Soya vicilin, homologous to peanut vicilin, has also been reported to be a major soya allergen. Four major protein fractions of soyabean have been isolated and studied for allergenicity. Gly m IA and Gly m IB have been identified as responsible for soya bean induced asthma. Thermal denaturation of soyabean protein does not affect IgE and IgG specific binding activity. A case of fatal anaphylactic reaction has been reported. It has been reported from Sweden that soyabean allergy is underestimated as a risk factor for severe reactions.

Among legumes extensive cross reactivity has been reported by in vitro methods. However most peanut allergic patients did not show allergic reactions on consumption of other legumes.

The members of the legume family can provoke immediate hypersensitivity reactions in susceptible individuals. Further the dietary habits of people likely influence the food sensitivities found in different countries.

In India, where majority population is vegetarian, the diet consists mainly of cereals, pulses and vegetables. Due to economic reasons, even the non-vegetarian’s diet consists mainly of cereals and pulses with egg, fish, chicken etc. consumed in moderate quantities, two-to-three-times a week. Red gram (Cajanus cajan), lentil (Lens esculenta), black gram (Phaseolus mungo), green gram (Phaseolus aureus), pea (Pisum sativum) and chickpea (Cicer arietinum) are the major pulses used in the diet of an average Indian. Among these legumes, chickpea is the most common, especially in its flour form, consumed in a variety of preparations. Chickpea flour is mainly used as a thickening agent.

Roasted and puffed chickpea is a popular snack for most Indians. A study was undertaken for the chickpea hypersensitivity cases. It was diagnosed with skin tests, double-blind placebo-controlled food challenges (DBPCFC) and ELISA in 59 patients who indicated positive histories to chickpea. The major allergies in chickpea-sensitive patients have been detected with immuno-blotting. It was concluded that chickpea is an important source of allergen that can cause IgE-mediated hypersensitivity reactions ranging from rhinitis to anaphylaxis. The work was also done on the identification and characterization and characterization of etc al a major chick pea allergen in the Indian subcontinent.

Cereal

Cereals are the main ingredient of Indian diet and consumed in different forms in daily meals. Double blind placebo control food challenges (DBPCFC) studies conducted in atopic dermatitis patients demonstrated that 80 per cent patients reacted to only one grain. Cereals such as rice, wheat, rye, barley and oat have been reported to give allergic reactions in western countries and Japan in many atopic patients, as shown by extensive RAST and skin test reactivity. In Indian population, there are no published reports on allergy caused due to ingestion of cereals. Systematic work needs to be conducted to find the frequency of allergic reactions to cereals in Indian population. This will assume importance with the introduction of transgenic plants and GM foods in India. Asthma caused by ingestion of wheat has been confirmed in many food sensitive patients in other countries. Exercise induced anaphylactic reaction to grain flour ingestion has been reported. IgE antibodies have been found against globulins glutenins present in wheat. In Coeliac disease, gliadin, a 70 per cent alcohol soluble component of wheat, is the responsible component and is a cell mediated reaction. Glutenin sensitive enteropathy is a mal-absorption syndrome characterized by anemia, diarrhoea, and bone pain and this is treated with specific diet. Cross-reactions exist among cereal grains and grass pollen in children with food hypersensitivity. Wheat α-amylase inhibitor has been reported to give allergic reaction. Several proteins with sequence similarity in a single protein family were identified as major allergens in rice, wheat and barley.

Rice allergen Ory s1, a major allergenic protein in rice, shows considerable similarity to barley trypsin inhibitor and wheat α-amylase inhibitor. Rice grains are source of food allergens in atopic dermatitis whereas wheat and barley flour are source of inhalant allergens in asthma. Rice 16-kda allergen has been studied in great detail including its structure by Japanese workers. Barley Hor v1, a 14.5 kda endosperm protein, has been identified as a major allergen in barley.
Structural and cDNA sequence data of allergenic proteins in cereals suggested that most of these allergens from cereals belong to α-amylase/trypsin inhibitor family. New low allergenic strains of rice allergen have been produced by biotechnological methods. However, biotin deficiency has been observed in an infant fed amino acid formula and hypoallergenic rice. Food allergy to cereals is rare in western countries but eastern Asian countries where cereals are the staple food allergenic reactions to cereals should be watched.

Sea Foods

Many individuals show a wide range of allergic reactions such as abdominal discomfort to anaphylaxis and oral allergy (itching of mouth angioedema of lips, tongue etc.), after consumption of certain varieties of fish or shellfish. Cod fish allergen Gad c1 has been reported to be a small protein belonging to co-binding paral serum albumin.

Salmon Sal s1 has been shown to be a major allergen of Atlantic salmon fish. Many of the allergens from fish and crustaceans are heat stable and resistant to proteases. A severe case of fatal allergy in which the fish sensitized patient died after eating potatoes fried in the same pan used for fish has been reported by Yuninger.

The presence of cross-reacting heat stable allergens in crustacean food was first reported by Hoffman et al. A major allergen tropomyosin, the muscle protein, has been identified and characterized from Indian shrimp (Penaeus indicus).

Although India has a large sea coast and a vast population regularly consume fish and shell fish only a few isolated studies on fish allergy have been reported. This however does not mean absence of sea food allergy in India.

Tree Nuts and Seeds

In India lots of dry fruits are consumed in different forms. Hazel nut, cashew nut, almonds have been shown to elicit allergic reaction in a few atopic patients. There is evidence of increasing incidence of allergic reactions to some foods especially peanuts. It is reported that patients with peanut or tree nut allergies are faced with several challenges when eating in restaurants and other food establishments although particular types of cuisine (e.g., Asian) and particular types of foods (e.g., baked goods and ice creams) pose particular risks. Tree nuts are among the most common foods to cause allergy in Scandinavia and the United States. Yunginger et al. studied cases of food related fatal anaphylaxis involving one of the patients allergic to pecan. Anaphylactic reactions to walnut and cashew nut have been reported in many patients. Brazil nut protein was identified as an allergen in soybean that had been genetically modified to express Brazil nut 2S albumin as a source of methionine. As a consequence, this transgenic soybean was removed from the market. Neoaallergens appearing during storage of foods may also cause anaphylactic reactions as reported in peacan nut.

Information on seed allergy is scanty however there are case reports of anaphylactic reactions to sunflower seed, sesame seeds, poppy seeds, cotton and mustard seeds. It is therefore necessary to study the new genetic engineered plants such as Bt-cotton from this angle as the cotton seed meal or oil are used in some foods and allergenic principle could come in some form even through the milk of cattle consuming such seeds. Sesame seeds could cause severe anaphylactic reactions. Mustard seed allergen is a seed storage protein. Two major allergens from mustard seeds have been characterized. Anaphylaxis caused by cotton seed-protein containing candy ingested on a commercial airliner has been reported.

Allergy to Oral Drugs and Food Additives and Functional Foods

Many ingested drugs show allergic reactions in atopic individuals. Common drugs such as, sulpha aspirin, some antibiotics, and nitrates show allergic reactions in many patients. Cutaneous symptoms include urticaria, angioedema, rash; gastrointestinal symptoms that includes pruritus, swelling of the eyes, and tongue; respiratory symptoms include rhinitis wheezing etc. Some reactions could be pseudo allergic non-IgE mediated. Even allergic reactions to intravenous injection of dye used for diagnosis have been reported. Certain antibiotics such as penicillin are known to produce severe anaphylactic reactions on injection and such patients may elicit cross reactivity to other β-lactam antibiotics. Private practitioners have almost stopped using penicillin in India.
Diagnosing an allergy or intolerance to additives normally involves carrying out double blind placebo controlled oral provocation tests with food additives. The allergic reactions to food additives particularly occur against additives that are organic in nature.

Food additives such as caramine, tetrazine dyes used as food colors in medicines, cosmetics and sweets are known to cause food anaphylaxis after ingestion. Anaphylactic reactions due to ingestion of caramine containing food such as yogurt, campari have been identified, and specific antibodies to caramine have been detected. Reports of sulphite triggered asthmatic reactions in some sensitive patients captured the attention of food quality regulators and use of sulphite in foods is now reduced.

Functional foods are getting popular as health supplements. There have been reports of allergic reactions to such processed mixtures of foods. Hence in safety assessment of such foods, allergenicity needs to be assessed.

**Selection of Allergenic Foods for Product Labelling**

Several reports on food allergic reactions after consumption of minute amounts of allergenic foods leading occasionally to life threatening conditions have lead to the idea of labeling the foodstuff for the presence of known allergenic components. Various government regulatory agencies have taken increased notice of food allergies. Canadian labeling regulations require that package food products contain a list of ingredients that includes specific declaration of majority of components of that product and enforced food product recalls because of the unlabelled presence of allergenic foods in the product. In western countries especially in the US food allergies have become an important food safety issue. Three conferences for the South Asian regions have been organized under global FAO/ILSI cooperative framework to focus on the issues requiring attention of scientists, researchers, policy makers, agriculture and industry in the South Asian region. Because of globalization of food trade it is necessary to focus attention on the quality of the imported food to provide adequate assurance of safety to the consumers. Currently available information on food allergy in India and South Asian Region is insufficient to enforce any labelling of allergenic foods. The food industry could at least start indicating the composition of the package food on the label, to begin with.

**Genetically Modified Food (GM foods)**

Several crops are being modified by genetic engineering techniques for improved agronomic characteristics or for improving nutritional quality of foods. Genetic modification ultimately results in the introduction of new proteins, and their safety including potential allergenicity needs proper assessment. Targeting a single nutrient has been shown to result in other alterations and there is a concern of the potential hazard on consumption of such foods. Transgenic soybeans containing methionine/cysteine rich protein of Brazil nut (a potent allergen) have been cited as an example of how an allergen from one food can get transferred into another thereby increasing risk of its allergenicity.

However, these problems are focused and methods to evaluate safety of such GM foods are being introduced. It is easier to evaluate safety of GM foods if the gene source is known.

Certainly the products of agricultural biotechnology should be subjected to a careful and complete safety assessment before commercialization and they need be properly labelled.

**Therapy for Food Allergy**

The only proven therapy is the strict elimination of the offending allergen. However it can have side effects also, like malnutrition. It is really very difficult to observe strict elimination especially in India where prepared food is a complex mixture. Because of lack of clinical data from food, challenges allergists often recommend dietary restrictions to all cereal grains in patients with possible sensitivity to at least one grain.

Several drugs have been used to protect patients with food allergy such as, H1 H2 antihistamines, steroids, and sodium chromoglycate. However they only give short-term effect or no measurable effect. The efficacy of immunotherapy in food allergy is still controversial and could occasionally produce severe systemic reactions.

There have been many conflicting reports suggesting breast-feeding could prevent atopy and
food allergy. However it is now known that breast milk contains varying amounts of cytokines and immunoglobulins which the infant gets initially from the mother, and therefore may give conflicting results. Postponing introduction of food antigens up to 4-6 months is now promoted in several countries as a means of preventing food allergy. In India, in traditional system, foods other than breast milk are substituted later, after 3-4 months. This probably may have been the cause of lower prevalence of food allergy in children in India.

The criteria of placing a food on the list of allergenic foods have been formulated by Bousquet et al. as follows:

(a) Report of a properly conducted DBPCFC study confirming allergenicity.

(b) Reports of assessment of the severity of the reaction in foodstuffs causing severe systemic and life threatening reactions should be listed.

Indian food habits are different from those in western hemisphere as Indians eat a lot of complex mixtures of foods. Several spices make up flavour of a food. Also no systematic studies have been conducted on the prevalence of food allergy and the major allergenic common foods in Indian population and prevalence of severe food allergies is poorly understood. The high-risk allergenic foods reported in the western literature have not been found to show similar risk of suffering an allergic reaction in Indian population.

Conclusions

In summation, studies on food allergy are in its infancy in India, and need to be conducted systematically. The public, the media, the medical community and the food industry should be aware of the potential for allergic reactions including anaphylactic from inadvertent consumption of specific offending food by a food allergic individual.

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