INTRODUCTION

Peanut-allergic patients are known to have more severe symptoms than those produced by other food allergies. They may react to even minute amounts, and come into contact with peanut through various routes, including inhalation of peanut particles. The prevalence of peanut allergy has increased. This is probably due to a combination of the recent rise in atopic diseases, peanut-specific factors such as use of peanut in a wider range of products, increased peanut consumption (knowingly or through hidden sources), use of peanut-containing non-food products (e.g. cosmetics), transfer of peanut through breastfeeding, and other factors. This article focuses on the factors that influence sensitisation to peanut as well as the factors that affect peanut’s allergenicity. Points discussed include peanut’s wide range of sources (both obvious and not) in food and non-food products, the allergens present in peanut and their cross-reactivity, how cooking affects allergenicity, conditions that have been associated with adverse reactions to peanut, and causes of non-allergic reaction to peanut such as histamine and aflatoxins.

SENSITISATION TO PEANUT

Peanut allergy usually presents after a period of sensitisation to peanut. However, some children have severe reactions during their apparent first exposure. But patients could have been previously sensitised to minute amounts of the allergen through breast milk, through peanut hidden in foods, or through inhalation of peanut dust particles; it is particularly relevant that peanut oil is widely used in many consumer products (including infant formulas and vitamin D preparations).

SUMMARY

Peanut-allergic patients are known to have more severe symptoms than those produced by other food allergies. They may react to even minute amounts, and come into contact with peanut through various routes, including inhalation of peanut particles. The prevalence of peanut allergy has increased. This is probably due to a combination of the recent rise in atopic diseases, peanut-specific factors such as use of peanut in a wider range of products, increased peanut consumption (knowingly or through hidden sources), use of peanut-containing non-food products (e.g. cosmetics), transfer of peanut through breastfeeding, and other factors. This article focuses on the factors that influence sensitisation to peanut as well as the factors that affect peanut’s allergenicity. Points discussed include peanut’s wide range of sources (both obvious and not) in food and non-food products, the allergens present in peanut and their cross-reactivity, how cooking affects allergenicity, conditions that have been associated with adverse reactions to peanut, and causes of non-allergic reaction to peanut such as histamine and aflatoxins.
Their IgE binding properties are also similar, and therefore there is no difference in allergenicity between species. In apple, in contrast, the allergenicity varies according to the type of apple and its maturity (ripeness). These facts indicate that differences in the serology of peanut allergy might not originate from differences in the allergen composition of the peanuts. High-oleic peanut is a new peanut variety developed by the University of Florida and known as SunOleic. It contains approximately 80% oleic acid, compared with 50% oleic acid in normal peanuts. SunOleic has a longer shelf life and lowers cholesterol levels significantly in patients with hypercholesterolaemia. There is no difference in allergenicity, however, between normal and high-oleic peanuts.27

ALLERGENS IN PEANUT

An individual can have an allergy to one or more of the allergens in peanut. Various percentages of the population are allergic to the various allergens. Several allergens have been isolated: Ara h 1 (vicilin, a seed storage protein), Ara h 2, Ara h 3, Ara h 4 (a seed storage protein), Ara h 5 (a profilin), Ara h 6 and Ara h 7 (2S albumins, seed storage proteins). Ara h 1, Ara h 2 and Ara h 3 are major peanut allergens and have been recognised by IgE in more than 95% of peanut-sensitive individuals. These allergens, in particular Ara h 1, have been shown to be stable to digestion and to survive most food-processing methods.28

Peanut allergens that have been isolated include pan-allergens such as profilin, lipid transfer proteins (LTPs), chitinase and 2S albumin.29 These allergens cross-react with a broad range of foods. LTPs are heat-stable allergens, but profilin is heat-labile.22,23 Because of the extreme resistance of LTPs to pepsin digestion, LTPs in particular are potentially severe food allergens.22 The presence of the panallergen chitinase may explain the cross-reactivity seen between latex and various fruits as well as between latex and peanuts. The seed storage protein 2S albumin has been identified in edible seeds and nuts such as mustard, sesame, Brazil nut, walnuts and peanut.24 This may be the reason peanut cross-reacts with tree nuts.

The cross-reactivity among foods containing the same panallergens can be high. LTP is one such panallergen, but other panallergens result in only low cross-reactivity among the foods containing them; vicilin is an example. The peanut vicilin shares significant sequence homology with the vicilin storage proteins of other legumes, e.g. soybean, pea, common bean.28 This does not necessarily indicate clinical cross-reactivity but would explain why specific IgE to other legumes may be found in serum.

The crux of the problem of a reaction to a panallergen is that the patient is at risk of cross-reacting to a broad range of foods that are not related by family. Where peanuts are concerned, however, the greatest risk is simply a concomitant allergy to tree nuts (not related to peanuts by family, but a distinct group among themselves).

COOKING PEANUTS

The major allergens in peanut are heat-stable, and chemical denaturation appears to reduce their allergenicity only minimally. These allergens can resist gastric acid degradation.26

The protein concentration is approximately 16.6 g/100 g in raw peanuts, compared with approximately 2.6 g/100 g in roasted peanuts, preliminarily indicating more allergenicity in the former.27 However, it has been found that the allergenicity of roasted peanuts is higher than that of raw peanuts. Frying or boiling peanuts, as is done in China, appears to affect the allergenicity less than the dry roasting (including the method used for manufacturing peanut butter) practised widely in the USA. Roasting uses higher temperatures, which increase the allergenicity of the three major peanut proteins more than do the lower temperatures used for boiling or frying. This may help explain the difference in prevalence of peanut allergy observed in these two countries.22,26,23

Peanut allergens that have undergone the Maillard reaction (this occurs in foods during thermal processing and home cooking and is a non-enzymatic browning reaction between a protein and a reducing sugar) are more resistant to heat and digestion by gastro-intestinal enzymes than those that have not. Therefore, thermal processing may play an important role in enhancing the allergenic properties of peanuts, with the protein modifications made by the Maillard reaction contributing to this effect.20,21 The storage and roasting of peanuts can increase the content of other peanut constituents that may be clinically relevant (discussed below).

PRODUCTS MADE FROM PEANUTS

Peanuts can be eaten not only in the obvious forms (as a vegetable, crushed or ground as a ‘butter’, roasted or salted as snacks, incorporated into candy, and as an oil extracted by solvents or pressure), but can also be encountered in far less obvious forms, in a range of food and non-food products. These are discussed below.

Peanut oil

Peanut oil is obtained from the seed kernels of the plant.22 Highly processed oils (acid-extracted, heat-distilled) do not contain peanut protein and can safely be consumed by allergic patients. However, many of the oils on the market undergo minimal processing; they are cold-pressed or extruded peanut oils, with processing at lower temperatures. These oils (known as crude peanut oil) may contain traces of peanut protein and may induce allergic reactions in 10% of allergic subjects, in contrast to refined peanut oil, which does not pose any risk. Infant formulas manufactured with peanut oil have been shown to induce adverse reactions.25 Products that are derived from peanut oil include hydrogenated peanut oil, peanut acid and peanut glycerides. Peanut oils and glycerides are used in toiletries and cosmetics such as skin-conditioning agents, soaps, etc.
Peanut as a hidden allergen

- Peanut flour is obtained from grinding peanuts and is used as an abrasive, a bulking agent and a viscosity-increasing agent.
- Hydrolysed vegetable protein is used to flavour foods. The source is usually soya or wheat, but can also be peanut.11
- Peanut and peanut products are used in some animal and bird foods.11
- Restaurants may use peanut butter to thicken sauces; peanuts and peanut butter may be used in the glaze on roast meat, or in cakes, cookies and candies; potato chips and French fries and other fried food may be fried in peanut oil; also, the oil in a deep-fat fryer that has been used to fry peanut-containing food (e.g. vegetarian burgers) and is then reused may contaminate food.12 Some oriental restaurants use peanut butter to ‘glue down’ the ends of egg rolls to stop them from coming apart in the cooking process.9
- Chinese, Thai, Malaysian and Indian restaurants use peanuts and peanut products in many of their dishes.11
- Almond powder and chopped almonds imported from Asia sometimes contain powdered or chopped peanuts as a filler.15

N.B. E471 (a monoglyceride of fatty acids) and E472’s (lactic acid esters of diglycerides, acetic and tartaric acid esters of glycerides/DATEM, acetyl tartaric esters of glycercides, acetic acid esters of diglycerides or citric acid esters of glycerides) are food emulsifiers that would be acceptable for peanut-allergic patients to use. If peanut oil was used as the source in these additives, the risk of an allergic reaction would be extremely low, as the oil would have been refined.26

Peanuts are concealed in various kinds of foods because they are rich in protein, are often used to change the viscosity of other foods, and can be used as substitutes for more expensive products. American and Asian cuisines especially use peanuts in a wide variety of recipes.27

Sometimes no differentiation is made in marketing peanuts and other nuts, and the two are sold together in ‘nut mixtures’. Contamination can occur in the processing of nuts and nut-containing products. Utensils used to handle peanuts may be used on ‘bulk nuts’ without cleaning intervention. In the manufacture of confections such as candies and ice creams, cross-contamination between peanuts and other nuts can also easily occur. It is therefore suggested that persons with severe peanut allergy avoid products containing any type of ‘nuts’, because of the danger of traces of peanuts.28

"Mandalona" nut is one of the names given to a manufactured product made from deflavoured, decoloured peanut meal that is pressed into moulds, relavoured and coloured, and sold as a substitute for tree nuts such as walnuts, almonds and pecan nuts.9

In the past, food manufacturers had to print on food labels the words ‘May contain traces of peanut’ when there was a possibility that the product might contain traces of peanut. This statement has, however, been abused by many manufacturers. They have been known to put the statement on all products – even on those that could not possibly contain peanut. This of course renders the statement useless to consumers, or even harmful, since it can unnecessarily reduce the dietary choices of the peanut-allergic. The latest draft of South Africa’s labelling legislation, in trend with international practices, requires food manufacturers to clearly indicate whether a product contains peanut or not. The manufacturers, therefore, must have the product tested to determine whether peanut is present or not. Fortunately there are very sensitive immunoassays available to test for the presence of allergens, including peanut, in products.

CONDITIONS THAT HAVE BEEN ASSOCIATED WITH ADVERSE REACTIONS TO PEANUT

- Adverse reactions to peanuts have occurred through dermal contact, inhalation and ingestion of peanuts, peanut oil, peanut-containing products and/or peanut dust.12
- Peanut allergens have been transmitted to allergic individuals by kissing, by eating from a food utensil that has been in contact with peanuts, and also by playing cards.44
- Contact has occurred through ointments and massage oils containing peanut oil.45
- In-flight allergic reactions to peanuts have been reported from ingestion, dermal contact, and inhalation in airplanes.12
- Adverse reactions to peanuts can be hastened by alcohol ingestion, by the taking of aspirin, and by exercise (food-dependent exercise-induced reaction). The first two increase gut permeability, and the last increases blood flow in the body.43
- The amount of fat that accompanies the ingestion of peanuts has a profound effect on any reaction to the peanut allergens experienced. This is another factor to be considered in assessing the risk of certain foods to food-allergic consumers and adds another dimension to clinical, research and regulatory practice.47
- Occupational exposure to peanut allergens or to the mould on peanuts can occur orally, by contact, or by inhalation of peanut dust. Animal, cosmetic, dock, refinery, chemical and laboratory workers are susceptible.
- Asthmatics with peanut sensitivity (as with any
other food sensitivity appear more likely to develop fatal reactions. This is probably due to the sensitivity that asthmatics have to endogenous mediators such as histamine, leukotrienes and prostaglandins produced by acute food-allergic reactions.5,6

- There have been reports of transfer of symptomatic peanut allergy from the bone-marrow transplant donor to the recipient,48 as well as transfer of the allergy to the recipient of a combined liver-and-kidney transplant.49
- Proteins from peanut in a mother’s diet can be passed through the breast milk and cause allergic reactions in the breastfed infant. The elimination of peanut and peanut-containing foods from the mother’s diet should alleviate the problem.8 The younger a person is at his/her first exposure to peanuts, the earlier the onset of symptoms. Exclusive breast-feeding does not protect an infant against the development of peanut sensitisation. Sensitisation is likely to occur in proportion to the frequency of the mother’s peanut intake during pregnancy and the earlier peanuts are introduced to the infant’s diet.50,51
It has also been shown that peanut allergy now presents earlier in life, possibly as a result of increased consumption of peanut by pregnant and lactating mothers.52 The incidence has increased with succeeding generations, and this may also be because of the increasing exposure of children to peanuts at a young age.53

NON-ALLERGIC REACTIONS TO PEANUT

Histamine

Peanuts naturally contain histamine. The storage and roasting of peanuts increase the histamine content, possibly promoting allergy-like symptoms. Histamine concentration is 0.08-0.56 nmol per 100 g of raw peanuts compared with 35-150 nmol for 100 g of roasted peanuts. Fermentation processes are likely to generate a large quantity of histamine. This could explain the differences in the intensity of the disorders occurring after ingestion of the same quantity of peanuts.27 It should be remembered that adverse reactions to histamine occur with a dose effect—the more histamine ingested, the worse the symptoms experienced. Also, one should consider the consequences of alcohol being a histamine-liberator. In situations where alcoholic beverages are consumed in combination with a histamine-containing food, as in a bar where peanuts are available as a snack, the adverse effect experienced could be more severe.34

Aflatoxins

Any product can have moulds that produce aflatoxins when the product is stored. Moist conditions are especially “friendly” to aflatoxins. Grain and peanut products are particularly susceptible. High levels are most commonly found in maize, but peanuts can also contain high levels. (Peanut oils and products derived from them do not contain aflatoxins.) Aflatoxins have been associated with oesophageal cancer. There have also been reports of cirrhosis in children caused by contaminated peanut meal. Authorities usually check for a safe aflatoxin level in the product, but this is not always done in Third World countries and rural areas.52,53

Sodium salicylates

Peanuts contain sodium salicylates, but whether sodium salicylates result in adverse reactions is controversial. As an example, Dahi54 showed that aspirin-sensitive asthmatics with dramatic peak flow changes following a challenge with aspirin in doses up to 200 mg demonstrated no changes to a sodium salicylate challenge with doses up to 2 000 mg.55,56

PERSISTENCE OF PEANUT ALLERGY

Peanut allergy raises major concerns and requires diligence in families because of the possibility of severe reactions, the relatively common inability to outgrow peanut allergy, and the widespread availability of peanuts in the Western diet. However, peanut allergy is outgrown in approximately 22% of children, and outgrowing is especially likely in those with histories of only cutaneous reactions and with current low peanut-specific IgE levels. The patients with milder reactions on presentation have a better chance of developing tolerance to peanuts than the patients whose first reaction was anaphylaxis.58,59

CONCLUSION

It is hoped that this article provides insight into some of the practical aspects of peanut allergy. This summary may help in understanding why this is such a common allergy, how easily sensitisation can take place, and how difficult avoidance is. Health professionals should be aware of all possible routes of exposure to the allergen that may lead to sensitisation or to an allergic reaction in already sensitised individuals, and clinical practice and patient education should be adjusted accordingly. Experts in the field of allergy are already recommending that pregnant and breastfeeding women whose children are at particular risk of developing peanut allergy avoid all peanuts and peanut-containing products in their diets. It is also suggested that peanuts be avoided by high-risk infants until the age of 3 years.56,60

REFERENCES

16. Park CW, Kim GI, Lee CH. A comparison study on allergen compo-


