Do dietary lectins cause disease?

The evidence is suggestive—and raises interesting possibilities for treatment

In 1988 a hospital launched a “healthy eating day” in its staff canteen at lunchtime. One dish contained red kidney beans, and 31 portions were served. At 3 pm one of the customers, a surgical registrar, vomited in theatre. Over the next four hours 10 more customers suffered profuse vomiting, some with diarrhoea. All had recovered by next day. No pathogens were isolated from the food, but the beans contained an abnormally high concentration of the lectin phytohaemagglutinin. Lectins are carbohydrate binding proteins present in most plants, especially seeds and tubers like cereals, potatoes, and beans. Until recently their main use was as histology and blood transfusion reagents, but in the past two decades we have realised that many lectins are (a) toxic, inflammatory, or both; (b) resistant to cooking and digestive enzymes; and (c) present in much of our food. It is thus no surprise that they sometimes cause “food poisoning.” But the really disturbing finding came with the discovery in 1989 that some food lectins get past the gut wall and deposit themselves in distant organs. So do they cause real life diseases?

This is a non-academic question because diet is one part of the environment that is manipulable and remediable.
because lectins have excellent antibodies, at least in vitro. Because of their precise carbohydrate specificities, lectins can be blocked by simple sugars and oligosaccharides. Wheat lectin, for example, is blocked by the sugar N-acetyl glucosamine and its polymers. These natural compounds are potentially exploitable as drugs should lectin induced diseases be identified.

Wheat gliadin, which causes coeliac disease, contains a lectin like substance that binds to human intestinal mucosa, and this has been debated as the “coeliac disease toxin” for over 20 years. But coeliac disease is already managed by gluten avoidance, so nothing would change were the lectin hypothesis proved. On the other hand, wheat lectin also binds to glomerular capillary walls, mesangial cells, and tubules of human kidney and (in rodents) binds IgA and induces IgA mesangial deposits. This suggests that in humans IgA nephropathy might be caused or aggravated by wheat lectin; indeed a trial of gluten reduces proteinuria and immune complex levels.

Of particular interest is the implication for autoimmune diseases. Lectins stimulate class II HLA antigens on cells that do not normally display them, such as pancreatic islet and thyroid cells. The islet cell determinant to which cytotoxic autoantibodies bind in insulin dependent diabetes mellitus is the disaccharide N-acetyl lactosamine, which must bind tomato lectin if present and probably also the lectins of wheat, potato, and peanuts. This would result in islet cells expressing both class II HLA antigens and foreign antigen together—a sitting duck for autoimmune attack. Certain foods (wheat, soya) are indeed diabetogenic in genetically susceptible mice. Insulin dependent diabetes therefore is another potential lectin disease and could possibly be prevented by prophylactic oligosaccharides.

Another suspect lectin disease is rheumatoid arthritis. The normal human IgG molecule possesses carbohydrate side chains, which terminate with galactose. In rheumatoid arthritis much of the galactose is missing, so that the subterminal sugar—N-acetyl glucosamine—is exposed instead. These deficient IgG molecules feature strongly in the circulating immune complexes that cause fever and symptoms. In diet responsive rheumatoid arthritis one of the commonest trigger foods is wheat, potato, and peanuts. This would result in islet cells expressing both class II HLA antigens and foreign antigen together—a sitting duck for autoimmune attack. Certain foods (wheat, soya) are indeed diabetogenic in genetically susceptible mice. Insulin dependent diabetes therefore is another potential lectin disease and could possibly be prevented by prophylactic oligosaccharides.

Among the effects observed in the small intestine of lectin fed rodents is stripping away of the mucous coat by abnormal bacteria and protozoa. Lectins also cause discharge of histamine from gastric mast cells, which stimulates acid secretion. So the three main pathogenic factors for peptic ulcer—acid stimulation, failure of the mucous defence layer, and abnormal bacterial proliferation (Helicobacter pylori) are all theoretically linked to lectins. If true, blocking these effects by oligosaccharides would represent an attractive and more physiological treatment for peptic ulcer than suppressing stomach acid. The mucus stripping effect of lectins also offers an explanation for the anecdotal finding of many allergists that a “stone age diet,” which eliminates most starchy foods and therefore most lectins, protects against common upper respiratory viral infections; without lectins in the throat the nasopharyngeal mucus lining would be more effective as a barrier to viruses.

But if we all eat lectins, why don’t we all get insulin dependent diabetes, rheumatoid arthritis, IgA nephropathy, and peptic ulcers? Partly because of biological variation in the glycoconjugates that coat our cells and partly because these are protected behind a fine screen of sialic acid molecules, attached to the glycoprotein tips. We should be safe. But the sialic acid molecules can be stripped off by the enzyme neuraminidase, present in several micro-organisms such as influenza and streptococci. This may explain why diabetes and rheumatoid arthritis tend to occur as sequelae of infections. This facilitation of lectins by micro-organisms throws a new light on postinfectious diseases and makes the folklore cure of fasting during a fever seem sensible.

Alternative medicine popularisers are already publishing articles about dietary lectins, often with more enthusiasm than caution, so patients are starting to ask about them and doctors need to be armed with facts. The same comment applies to entrepreneurs at the opposite end of the commercial spectrum. Many lectins are powerful allergens, and prohevein, the principal allergen of rubber latex, is one. It has been engineered into transgenic tomatoes for its fungistic properties, so we can expect an outbreak of tomato allergy in the near future among latex sensitive individuals. Dr Arpad Pusztai lost his job for publicising concerns of this type (20 February, p 483).

David L J Freed

14 Marston Road, Salford M7 4ER