

Lectins

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A new nutrition

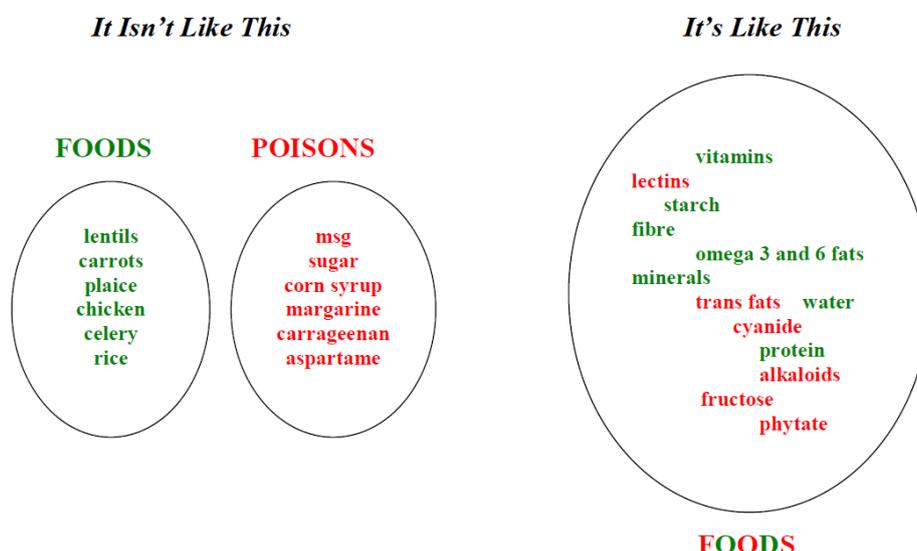
Nutrition used to be about how to obtain everything we need from food. Milk gave you calcium, meat gave you iron, and fruit gave you vitamin C. That was relatively simple. However, we are learning that foods are mixtures of good and bad, and that somehow we need diets that give us enough of the essentials, while minimising harmful chemicals. We need to obtain our nutrients, while avoiding too large an intake of anti-nutrients. Worse than that, some chemicals in food are both good and bad. Glucosinolates protect us against cancer, but too much make us hypothyroid. Other foods are good for some people and bad for others. For example, bioflavonoids protect against coronary heart disease, but are tolerated only in small quantities by those with low phenolsulphotransferase, or low sulphate production.

Animals and plants are not designed for us to eat them. [25] Their task is to keep their own species going. We have to make the best of what foods are available. They are not perfect for us, which may be why we do not live forever.

Many people think that there are two separate categories: foods and poisons. It would be easier if it were like that. There is a spectrum between foods that most people can eat without symptoms, and toxic substances that we all must avoid, with a grey area in the middle. More sensitive people cannot tolerate foods in the grey area, while most people seem to cope, but may well end up with something nasty eventually, like cancer, coronary heart disease, type one or two diabetes, or a neurological disease like Parkinson's or motor neurone disease. Foods are a mixture of chemicals, some healthy and some not. For example, milk contains calcium for bones and teeth, but it also contains galactose, which harms the arteries, and milk fat globule membrane, which promotes clotting.

Effective nutrition is also about having nutrients in the right ratios. Calcium is not the only mineral we need. We also need magnesium, and there is little of that in milk. Too much calcium makes you short of magnesium, as these two minerals compete for uptake. So calcium and magnesium need to be consumed in the right ratio. If you are going to eat cheese, which is high in calcium but low in magnesium, then you need to balance it with a source of magnesium, like nuts or green leaves. [21]

Figure 1: Toxins in Foods



Why do whole grains and pulses cause so much trouble?

I observed that some of my clients had diarrhoea after eating whole grains or whole pulses, but ate refined grains and lentils, from which the skins had been removed, without a problem. Whole foods were meant to be healthy, weren't they? Wholemeal bread certainly contains a greater quantity of fibre, minerals and B vitamins than white. Yes, phytates in the skins of seeds reduce mineral absorption, but that should have a gradual effect, rather than triggering a reaction to a particular meal. I needed to learn about lectins. I shared my observation with my lectinologist friend, who was not at all surprised.

What are lectins?

What are lectins? My rusty school Latin told me that lego means I read or I choose. You can read from a lectern. You select a pair of shoes in the shop. You elect your MP. You play Lego, choosing what to build. Lectins are vegetable proteins that bind to sugars, and the glycan part of glycoconjugates. Most plants have them. They are concentrated in the bran layer of the seeds, although they may occur in bark, tubers, roots, fluid and gel. [29]. They are called lectins, because they "choose" the sugars to which they bind. [30] They bind tightly to these sugars wherever they find them in the body, interfering with the normal functioning of the tissue to which they bind. They ignore other sugars. They cause multiple changes in cell and body metabolism. [23] They may be antigenic, or adjuvant, leading to an immune response on their own, or when administered with other proteins. Lentils, kidney beans, peas, soya beans, broad beans, peanuts, roasted nuts, tomatoes, fruit juice, raspberries, breakfast cereals and spices, contain active lectins. Lectins bind to glycoproteins in cell membranes. Many such glycoproteins are receptors for cytokines and hormones. Whether or not they encourage cell division may depend on their concentration, which animal consumes them, which cells of the animal are involved, and on the closeness of the binding site to the sugar to which they bind.

Wheat, tomato and potato lectins attach to n-acetyl glucosamine, a sugar abbreviated as GlcNAc or GNAc, but known to the supplement world as NAG. [17] It is unfortunate that NAG is in the intestines, mouth, thyroid, heart muscle, pancreas, kidney, the myelin that protects the nerves, and many other places. Can we be surprised that some of those eating much bran, wholemeal bread and jacket potato come to us complaining of irritable bowel syndrome, arthritis, multiple sclerosis, auto-immune kidney disease, and various other chronic diseases? Some people have a rapid reaction to consuming lectins. For others the harmful effects may only become apparent after many years. Others may die in old age, without any such consequences. Some people may have a mild sensitivity to a lectin, and cope with white bread, peeled potatoes, tomatoes without their seeds, split peas, and split red, yellow or white lentils without their skins. Other more unfortunate people may need to avoid all bread, potatoes, tomatoes and pulses.

Red lentils are the insides of brown lentils, white lentils the insides of black lentils and yellow lentils the insides of green mung lentils, which are sometimes called mung beans. Immature seeds in courgettes are less of an issue than mature ones in marrows. Immature seeds in mange tout peas are often tolerated when garden peas are not. Some people are so lectin sensitive, that they have to restrict themselves to a "stone-age diet", of meat, fish, leaves and other low lectin vegetables like courgettes. This is not a diet that appeals to vegetarians.

It is thought that we are poorly evolved to cope with agrarian diets, and perhaps our domestic livestock have the same problem. Pigs fed a cereal free "hunter-gatherer" diet had significantly higher insulin sensitivity, lower diastolic blood pressure and lower C-reactive protein than pigs on conventional pig feed. [22]

Peas, lentils, peanuts, kidney beans, soya beans, tomatoes, edible snails and mushrooms have different lectins, which have various targets in the body. Milk contains lectins derived from the cow's diet, at least for part of the year. Cheese contains lectins in moulds growing in or on it. Some foods like tomatoes, peas and lentils have two favourite sugars, rather than just one. There are people who have to avoid all these foods, at least for a while. Whole foods are not wholesome for everyone.

Table 1. Common Lectins in Foods, and the Sugars to Which they Bind.

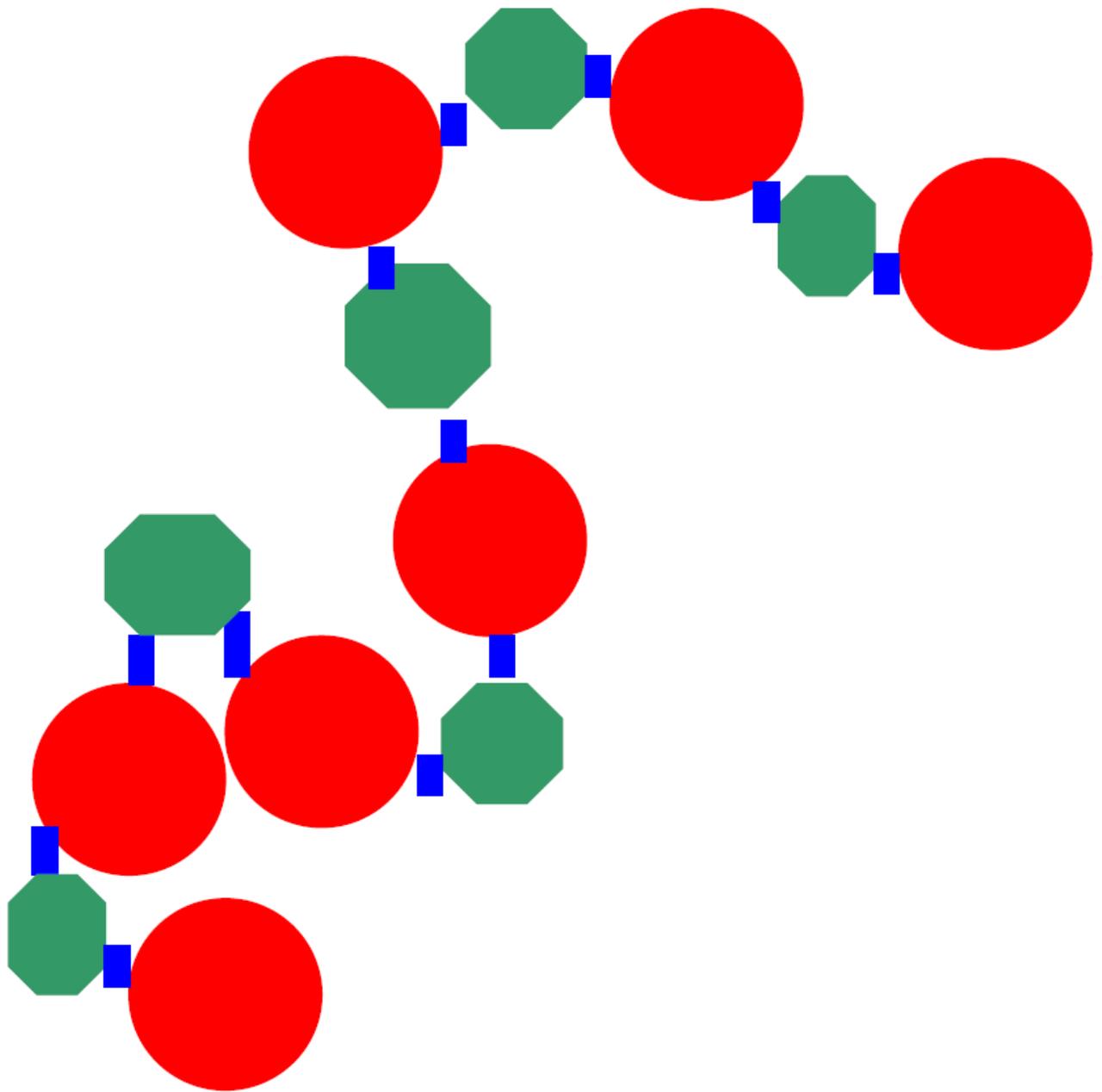
Food	Lectin	Sugar	Abbreviation of sugar
Wheat	WGA	n-acetyl glucosamine	GNAc
Pea	PSA	mannose, glucose	Man, Glc
Lentil	LCA	mannose, glucose	Man, Glc
Peanut	PNA	galactose	Gal
Kidney bean	PHA	galactose oligomers	Gal oligomers
Lima bean	LBL	n-acetyl galactosamine	GalNAc
Broad bean	VFA	mannose, glucose	Man, Glc
Tomato	LEA	n-acetyl lactosamine, n-acetyl glucosamine	LactNAc, GNAc
Potato	STA	n-acetyl glucosamine	GNAc
Soya bean	SBA	n-acetyl galactosamine	GalNAc
Mushroom	ABL	galactose	Gal
Edible snail	HPA	n-acetyl galactosamine	GalNAc

Agglutination

Stillmark did not like to cause suffering to animals. So he carried out toxicology experiments on blood. He found that some plant extracts caused the cells to clump together. This clumping is called agglutination, and the clumping of blood cells is called haemagglutination. Lectins may have more than one binding site, and agglutinate cells to which they bind. [23] So they are haemagglutinins. They are used to type blood for transfusions, as they identify

glycolipids (carbohydrate-lipid combinations) and glycoproteins (carbohydrate-protein combinations) on red blood cells.

Figure 2. How Lectins With Two Binding Sites Make Red Cells Clump Together.



Lectin



cell



binding site

Why are many people allergic or sensitive to wheat?

The lectin in wheat is wheat germ agglutinin, or WGA. Table 2 shows which lectins attach themselves to which parts of the body. WGA attaches itself to many parts because NAG, the sugar to which wheat lectin binds, is in so many places in the body. Also wheat lectin is unusually resistant to cooking. [14] Is it any surprise then that eliminating wheat from the diet relieves many symptoms? In the West, wheat is eaten frequently and in greater quantity than most other foods. One can have whole-wheat cereal for breakfast, a biscuit at morning break, sandwiches for lunch, cake at tea-time, a chocolate covered biscuit on the way home, pasta for the evening meal, and a biscuit at bed-time. The more often we eat a food, and the greater the quantity we consume, the more likely we are to become sensitive to it. [13] Eating bran or wholemeal wheat increases the amount of lectin consumed.

Why do people NOT sensitive to wheat do well on avoiding wheat?

Cutting out wheat cuts out cakes, biscuits and much processed food, containing fructose, high fructose corn syrup, milk, hydrogenated oil, carrageenan, colourings, preservatives, flavourings and artificial sweeteners. So people may recover on giving up foods containing wheat, even if not sensitive to wheat itself. Beware recipes and free-from products that simply substitute for the wheat, but include the same sugar, milk and inflammatory carrageenan that come in mainstream products.

IgG helps us process food. Finding IgG to particular foods does not mean we are sensitive to them. IgG tests do not indicate sensitivity to particular foods. However, people may recover after IgG tests, because these pick out foods to which we make IgG, which are often frequently eaten foods like milk and wheat. Giving them up then eliminates two common causes of sensitivity, and also causes people to abandon some processed foods.

All fibre is not the same

Burkitt and Trowell worked at Makerere University in Kampala in Uganda, a university which has carried out important research on diet. Ugandans eat steamed green bananas as their staple food, and consume so much fibre that constipation and colon cancer are rare there. Matoke, or mashed green banana, is a tasty carbohydrate food, rich in magnesium.

Sadly Western doctors thought that whole grain wheat and bran would work as well. Westerners have been encouraged to consume large amounts of these foods, resulting in high WGA intake, and no doubt providing much work for the knee and hip surgeons, and the gastroenterologists. Undoubtedly the high fructose content in modern diets, from sugar, high fructose corn syrup and fruit juice is harmful, but refining grains has benefits. High sugar diets provide much fructose, which is harmful, but refined grains provide glucose, which is tolerable in moderate quantities.

Soya

The frequency with which soya appears in Table 2 does make one wonder about the wisdom of feeding infants soya formula, and of providing soya to milk sensitive clients. Well processed soya may be safe, but the consumer cannot check the processing of the individual brand. [25] Some children were found to react adversely to a soya formula containing sucrose. They recovered on a soya formula containing D-galactose, suggesting that soya lectin bound to D-galactose, which protected the children from the lectin. [9]

Animal studies

Animal studies, using wheat, kidney bean and other lectins have demonstrated effects, including delayed stomach emptying, atrophy of liver, stomach, thymus and spleen, impaired growth, disruption and inflammation of villi, increased intestinal weight, increased and decreased intestinal permeability, increased faecal weight, disruption of enzymes, reduced nutrient uptake, weight loss and gain, poor growth, slow body movements, and even death. [17,

Table 2. Where Lectins Attach Themselves in Human Beings.

Nasopharyngeal epithelium	WGA
Lips	WGA, LCA, SBA, PNA
Mouth	WGA, LCA, SBA, PNA, LEA
Salivary gland	WGA, SBA, PNA
Salivary Immunoglobulin A	WGA, PSA, PNA
Tonsil	WGA, SBA
Stomach	WGA
Parietal cells	PNA, SBA, LEA
Intestinal brush border	WGA, PHA, LEA, LCA, SBA
Colonic mucosa	WGA, PNA, PHA, LCA, SBA
Colonic mucus	WGA, PHA, LCA
Liver	WGA, PHA, PNA, SBA
Gallbladder	WGA, STA, SBA, HPA, PHA, PNA
Pancreatic duct	WGA
Glomerulus	WGA, SBA, PNA
Renal tubules	WGA, PHA, LCA, PSA, SBA, PNA
Urothelium	WGA
Prostate	WGA, PNA, LCA
Cervix/endometrium	WGA, SBA, PNA
Placenta	WGA,
Skeletal muscle	WGA, SBA, PNA, PSA, LCA
Cardiac muscle	WGA, SBA
Endothelium	WGA, PNA, SBA
Skin	WGA, LCA, PNA, SBA, HPA
Sweat glands	WGA, SBA
Connective tissue	WGA, PHA, LCA, STA, PSA
Breast	WGA, SBA, PNA
Cartilage	WGA, SBA, PNA
Pituitary	PNA
Thyroid	WGA, SBA, PNA
Thyrotropin (TSH)	LCA
Eye tissue	WGA, PNA, PHA, SBA, PSA
Tears	WGA, PNA, PHA
Inner ear	WGA, HPA, PSA, LCA, PHA, SBA
White blood cells	PHA
Mast cells	WGA, LCA, PSA, PHA
Platelets	WGA, STA, LCA
Axons	WGA, PSA, LCA, SBA, PHA, PNA
Myelin	WGA, PHA, LCA
Amnion/chorion	WGA, LCA, PNA

20, 2] Kidney bean lectin caused thinning of the mucous layer of the jejunum, removal of part of this layer, and overgrowth of abnormal microbes on the surface of the jejunum. [1]

The digestive system

Some lectins, including tomato lectin, bind to the parietal cells which are involved in secretion of hydrochloric acid. [5] Some lectins, including WGA and peanut lectin, attach to the surface epithelium of the digestive tract. [4] They may cause cell division in enterocytes. [23] Kidney bean lectin (PHA) is a powerful growth factor in the gut, causing enlargement due to hyperplasia (increase in the number of cells) and hypertrophy (increase in the size of cells). Lectins affect the permeability of the intestines.

In less developed countries, beans are an important source of protein, but firewood is often scarce in rural areas, and expensive in towns. Undercooked beans contribute to diarrhoea in these countries, which itself leads to malnutrition and often to death. [17]

Irritable Bowel Syndrome (IBS)

IBS is an umbrella term, covering various undiagnosed illnesses, which may be caused by excessive fructose consumption, antibiotic use, a whole food diet, lactose intolerance, coeliac disease, and various other causes. Often eliminating grains and pulses helps, but it may be enough to substitute white bread and red lentils for wholemeal bread and kidney beans. It is encouraging that a popular NHS gastroenterologist in South Manchester now recommends his IBS patients to avoid wholemeal and bran.

Inflammatory Bowel Disease (IBD)

IBD may also be lectin related.

Coeliac Disease

Coeliacs have more WGA, soya bean agglutinin and kidney bean lectin bound to the mucosa. WGA was found to bind to coeliac mucosa, even after a year's gluten free diet, but not to bind to the mucosa of non-coeliac children of low stature. [3] Soya intolerance is indistinguishable from wheat induced coeliac disease. Again, why not avoid kidney beans and soya if you are coeliac? Coeliac disease is also called gluten sensitive enteropathy, but other lectins appear to be important.

Peptic ulcers

Lectins strip away the mucous covering, at least in rodents. This not only removes the protection from the mucosa, but also encourages overgrowth of abnormal bacteria and protozoa. Lectins also cause discharge of histamine by gastric mast cells. This stimulates acid secretion. Thus lectins may encourage the development of peptic ulcers. Chitin is a long-chain polymer of NAG found in the shells of shellfish, mushrooms and yeast. WGA attaches to the stomach lining. It has been suggested that providing extra yeast in the diet may help treat stomach ulcers, as the WGA will be diverted from binding to the NAG in the stomach lining, to binding to NAG in chitin in yeast. Alternatively, a NAG supplement could be tried.

Auto-immune kidney Disease

Table 2 shows that some lectins attach to kidney tissue. WGA binds avidly to the glomerular capillary wall and tubules. It appears to be particularly relevant to IgA nephropathy. Kidney bean lectin enhances immune complex glomerulonephritis, at least in rabbits. [6] Other lectins that attach themselves to kidney tissue are soya, peanut, lentil and pea. There is evidence that these lectins are implicated in auto-immune kidney disease. [7] Is it not better to minimise lectin intake, rather than waiting to lose kidney function?

Rheumatic patches

Fox found that pain and loss of movement was often related to the presence of superficial painful areas that he called rheumatic patches. They are between the skin and muscle, in an area called superficial fascia or loose connective tissue. There is increased and haphazard deposition of collagen in rheumatic patches. Minerals are deposited there. Acupuncturists, osteopaths, chiropractors and masseurs use other names for the rheumatic patch, including trigger point. These patches can be identified by gentle pinching. A long time after the rheumatic patch develops, a joint may become arthritic. [12] The rheumatic patch may be at some distance from an affected joint, but it exerts force upon the joint. WGA attaches itself to heparin sulphate in connective tissue, making it stiffer. Thus minerals and one or more lectins appear to contribute to the stiffness of the rheumatic patch, and to the development of arthritic joints.

Many people have rheumatic patches on the surface of the body. Pressing them is uncomfortable, or painful. They may be just the size of a pea. Try gently pinching the skin. In some places, like the breasts, the tissues lift up easily, and only a small amount is pinched between the fingers. Perhaps we were designed not to develop rheumatic patches in the breasts, because of the benefits for breastfeeding infants. In other places, like above the breast, the skin is harder, and more difficult to pinch. You can practise comparing the tissue of the breast, and above, to learn how to identify rheumatic patches.

A tiny amount of a solution of sodium salicylate is injected into the rheumatic patch by a doctor or nurse, and pain, stiffness and weakness fade, regardless of the condition of the joint revealed by X ray. Salicylate is a chelator of metal ions. Metals attach to glycosaminoglycans in connective tissue,

holding water in the tissue. When the salicylate chelates the metal ions, the water is able to flow away, softening the tissues. [14] Pain goes, and mobility is restored.

Fibromyalgia is diagnosed when specific places have been examined for rheumatic patches, and sufficient of them have been found.

Arthritis

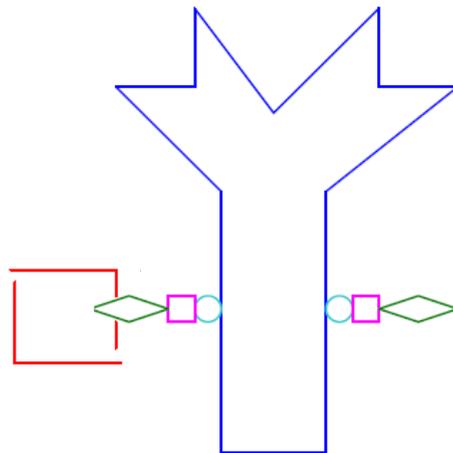
Injecting rabbits with lectins causes arthritis.

Rheumatoid Arthritis (RA)

Hicklin et al put rheumatoid arthritis patients on a diet that excluded grains, potatoes, milk and other foods suspected of being implicated in their disease. After 10-18 days, their condition improved. They deteriorated on challenge with individual foods, the category causing the greatest number of exacerbations being grains.

In rheumatoid arthritis the body does not form most IgG antibodies properly. [14] Galactose should be the final sugar in the side chains of the antibody, but in RA it is mostly missing, leaving NAG as the final sugar. [16] NAG is exposed to circulating wheat germ agglutinin, which attaches itself to it. Once WGA is attached to an antibody, the immune system identifies the combination as abnormal, and attacks, causing inflammation and pain. Properly formed antibodies have nowhere for the wheat lectin to bind. Lectins may be involved in other auto-immune diseases.

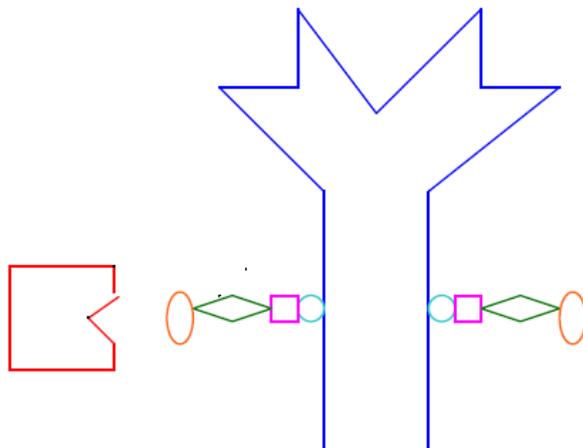
Figure 3. A Lectin Binds to an Antibody in Someone with Rheumatoid Arthritis.



Hurray, I've found the sugar I adore! Now I can cause mayhem.

Figure 4. The Lectin Cannot Bind to an Antibody in Someone Who Doesn't have Rheumatoid Arthritis.

Drat it! There's no way I can stick onto this antibody.



Osteoarthritis

Arthritic people often regain their mobility by taking NAG. Circulating wheat and potato lectins can attach themselves to this extra NAG, rather than attaching to NAG in body tissues. I do not find other forms of glucosamine as helpful.

Sjögren's Syndrome

Sjögren patients fail to put the sugar, sialic acid, on the end of IgG side chains. [17]

Type 1 Diabetes

WGA and many other lectins act like insulin. This may be why eating wheat makes some people fat. [17] Auto-immune diabetes is thought to be related to lectins, in this case those of wheat, tomato, potato and peanut. [16]

Immunity

After feeding lentil, edible snail, kidney bean, soya and peanut lectin to mice, IgG antibodies were found in serum, and after feeding kidney bean and soya, IgA antibodies were found, [8]

Lectins strip away the protective mucous layer in the respiratory tract, encouraging respiratory infections. [16]

Influenza viruses are divided into types, like H1N1 swine flu and H5N1 avian flu. The H stands for haemagglutinin, or lectin. It is probably the flu lectin that causes aching. The N stands for neuraminidase, also known as sialidase, which removes the sugar, sialic acid. Sialic acid protects our sugars in our bodies from lectin attack. When sialic acid is removed by flu viruses, or streptococci, we are vulnerable. [16] This may explain why diabetes and rheumatoid arthritis often occur after an infection. It may be wise to fast during a fever, to avoid eating lectins that can attack exposed tissues. [16] HIV can be activated into AIDS by deficiency of selenium, depletion of cysteine, or ingestion of a substantial dose of lectin. [15]

Lectins may increase the production of natural killer (NK) cells, protecting us from cancer, but cause apoptosis of immune cells, reducing our immune response.

Classical allergy

Classical allergy involves the antibody immunoglobulin E, or IgE, as opposed to other food reactions due to other mechanisms of hypersensitivity to foods. Grass and other pollens, house-dust mite faeces, grain dust, soya dust, banana, peanuts, eggs and latex contain lectins, and these may be involved in classical allergy to these substances. [17] Lectins may cause the release of histamine, and other inflammatory mediators.

Classical allergy is sometimes diagnosed using RAST blood tests, but lectins can confuse the results. [18]

Clotting

WGA strongly activates platelets. [19]

A Red Herring

Many genes affect our susceptibility to illness. Some of our genes are perfect, and enable us to make correctly the proteins for which they code. We may have a gene that does not work at all, leading to disability, or early death. However, some genes cause us to make proteins that are not quite right. They may have one element substituted for the correct one. We do function, but inefficiently, and we may have chronic health problems, and an early death. Lectins are involved in blood types, but it is not true that the only genes that matter in food sensitivity are those that determine our blood groups, or that these genes determine the diet we should eat.

Unfortunately you cannot just identify the right diet for someone by looking at blood type. There is no simple way to identify food sensitivities, because they depend on various factors, like how good the sulphation biochemistry is, whether there are toxic levels of vitamin A, whether the person is particularly susceptible to lectins, whether there is an overload of boron or fructose, whether there is lactose intolerance, fructose intolerance or fructose malabsorption, or whether there is too high a level of uric acid. Be wary of anyone who thinks food sensitivity can be diagnosed by a simple test, like a blood type test, a test for immunoglobulins, or using a machine. It needs knowledge and detective work to sort out food sensitivity.

Plant breeding

Spelt is old wheat, and does contain lectin. However, plant breeding has increased the lectin content of wheat. A student of mine said she had given up wheat, but still ate spelt. She was still unwell, and decidedly bad-tempered. I suggested stopping eating spelt, and she recovered her health and equanimity.

Genetic engineering (GE)

Ewen and Pusztai compared potatoes genetically engineered to contain snowdrop lectin, with potatoes that had snowdrop lectin added after harvest, and with ordinary potatoes. They found damage to the intestines of rats which ate the first two categories. [10] This research was suppressed, and he lost his job, allegedly after American and British political intervention. As with Wakefield and his colleagues and the MMR, the article by Ewan and Pusztai was published by The Lancet, and then withdrawn. [32, 31]

These transgenic potatoes have not been marketed, but there are transgenic tomatoes that contain prohevein to protect the plant against fungal attack. Prohevein is a lectin, and the main allergen in rubber. Latex allergy is common, and we cannot be surprised if tomato allergy becomes common in countries using foods altered by GE. [24]

Types of glucosamine

N-acetyl glucosamine in the blood can distract WGA from attaching itself to body tissues. It is also part of what is needed to repair tissues. It is more expensive than the other forms of glucosamine, but it works well. Indeed, it has been suggested that the other forms only work in so far as they are "contaminated" with NAG. Perhaps there should be a horse riding to the rescue on the tub. One of my friends loved country walks, but stiffness was making them difficult. NAG did indeed ride to her rescue, and she walks happily again.

Terrorist Use of a Lectin

Oils contain little lectin, and are therefore the easier part of a plant to tolerate. Some people who cannot eat even bread made from refined flour, may still be able to consume wheat germ oil without obvious ill effects.

Castor oil is an old remedy for constipation. However the castor oil seed contains a deadly lectin called ricin. It was used on the tip of an umbrella on a bridge in London to murder a Bulgarian employee of the BBC World Service. [14] More recently ricin was found in a London flat. Unarmed police were unwisely sent to a Manchester house, thought to be where ricin was stored, and one policeman was killed.

A most unhealthy dinner

Some but not all lectins are made less harmful by cooking, which suggests that muesli may not be as wise a food as is claimed. You are probably aware that beans must be well cooked. In particular, kidney beans can cause epithelial inflammation, causing diarrhoea and abdominal pain. [11] Lectins can also resist digestive enzymes. [16] In 1988, it was decided that a hospital should have one healthy eating day for the staff. It raises the question why there was no healthy eating on other days, for staff or patients. However, it turned out unfortunate that there was even one day. They served chilli con carne, but staff members noticed that the beans were too hard. Three hours later, a registrar in the operating theatre started vomiting. Other members of staff vomited profusely, some also developing diarrhoea. The cause of the incident was beans that happened to have a very high concentration of lectin, and which were not adequately cooked. [17] Clients who eat beans need to be warned to cook them well. Slow cooking is not adequate. [15] Green peas can however be eaten raw. [15] Sprouting pulses does reduce lectin content. [15] People who change their diets are not always aware of precautions needed with foods like kidney beans, mangoes and cashew nuts that are new to them. We should cook kidney beans and cashew nuts, and avoid the part of the mango near the stalk. .

Further reading

This article may be too detailed for some of our clients to wish to read it. For a briefer account of lectins, have a look at the Foods Matter website, or ask me for the article I wrote for Foods Matter on lectins. [27] Those interested in my summary of Kjaer and Frøkiær's chapter on lectins could also ask me for my review of the book to which they contributed. [26] Those wanting recipes for a low lectin diet could ask me for a copy of my book. [28]

Conclusion

Clinical experience suggests that lectins are implicated in many diseases. Much scientific work has been done on this matter, but much more remains to be done. Where diseases are confirmed as being caused by lectins, research is needed to ascertain whether giving the relevant sugars can reverse the diseases. [17] Funding of such research is of course an issue. Meanwhile, in my experience, a therapeutic trial of a low lectin diet is often successful, in chronically ill clients. We should also consider this when clients are suffering from an acute infection.

ACKNOWLEDGEMENTS

I am very grateful to my late friend and mentor, the lectinologist Dr. David Freed, for introducing me to this topic, and sharing his expertise with me. Any errors in summarising his ideas are of course my own. Most of the information in tables 1 and 2 and figures 3 and 4 is derived from his publications. I also thank Foods Matter for permission to reuse my diagrams for figures 3 and 4.

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