The Science of Lung Health

zestt
Nature first therapies

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MESSAGE FROM

Darcy & Anna

Hey there and thanks so much for downloading our "Science of Lung Health" guide and taking another step towards improving your lung and respiratory health.

How did we start this journey at Zestt?

Darcy suffers from sarcoidosis, an autoimmune disease that led to the development of small granulomas in his lungs which caused impaired lung function in the form of “Chronic Obstructive Pulmonary Disease (COPD).” Sarcoidosis and COPD are a constant challenge for Darcy - in his words:

“Nothing else matters when you can’t breathe.”

Darcy has worked hard and with the support of his medical community and his own research and actions he has significantly improved his lung function – his blood oxygen levels have increased from high 80s to mid 90s, all meaning he is able to breathe better and go faster - relatively speaking! He has also been able to reduce his rate of contracting respiratory infections.

As the two scientists who founded Zestt, we are driven to keep up with the latest research and stay ahead of the curve in terms of sharing information and products that might help you in your quest for better respiratory health. We have put this *free* "Science of Lung Health" guide together to help spread the word, that alongside pharmaceutical support, there are other things we can do to enhance our lung and respiratory health.

It’s never too late to make change, whatever path you have taken to get to this point – we believe you can improve your position and make your journey easier. Information we share here today is designed to support any medical diagnosis and advice you might have received - it is not intended to replace medical advice.

We are so glad you have joined our Zestt community, please let us know if you have any questions, thoughts or concerns.

All the best,

Anna Campbell (PhD) and Darcy Schack

How do lungs work?

In order to understand what goes wrong with our lungs, it is important to understand what goes right – so let's cover that first.
The most important function of our lungs is to take oxygen from the environment and transfer it to the blood stream – we do this by taking 6 million breaths per year.
The lungs are one of our largest organs. The surface area of both lungs is roughly the size of a tennis court. On top of that, the total length of the airways running through them is 2,400 kilometres – that's longer than the length of the whole country of New Zealand!
Our lung capacity depends on our gender, size, age and health – an average male's lungs can hold six litres of air.
Every day we breathe in enough air to fill up a decent sized swimming pool!

The left lung is slightly smaller than the right lung. When we breathe, our diaphragm, which sits beneath the lungs, does the muscular work. As the diaphragm contracts, it moves down, leaving space for the lungs to expand.
When we breathe, air goes from our nose and mouth, down the trachea (windpipe) where it splits into two branches, (mainstem bronchi), one of which leads to the left lung, one to the right.
Those two bronchi then split further, into multiple smaller and smaller bronchi, like branches on a tree.
This ever-decreasing pipework ends with the alveoli which are where the important gas exchange occurs – oxygen goes into the bloodstream and carbon dioxide comes out of the blood and is exhaled.

The lungs have functions other than breathing, including:

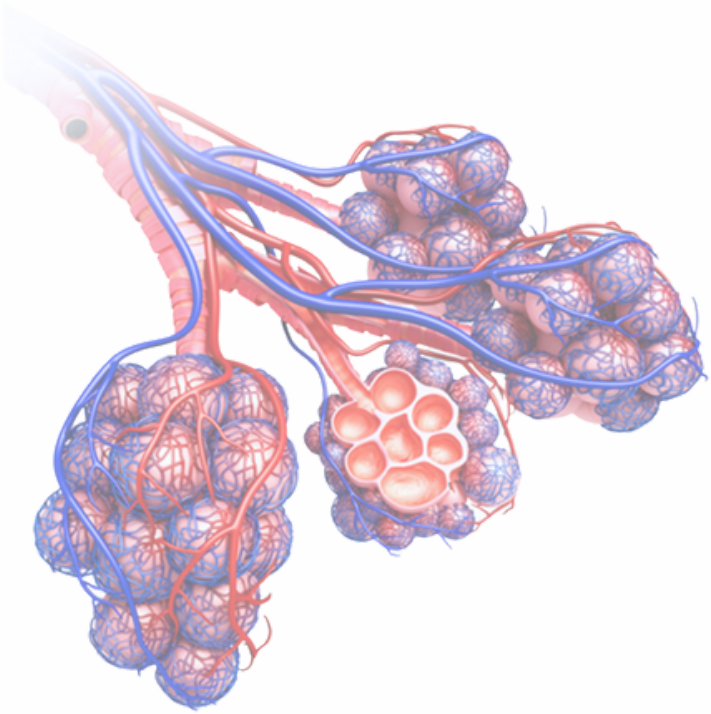
- Balancing pH - too much carbon dioxide can drop pH/increase acidity;
- Filtering small blood clots;
- A shock absorber for the heart during collisions;
- Infection prevention via membranes, which secrete immunoglobulin A;
- Clearing particles:
    - Mucus lining the lungs has an important function of trapping dust particles and bacteria;
    - Tiny hairs called cilia, move these particles upwards within the mucus so we can cough them out;
- A blood reservoir to interact with the heart, helping it function more efficiently;
- Airflow creation so we can talk.

Breathing - a well managed orchestra

Overall, our respiratory system is like a well-managed orchestra, keeping the beat at the macro level, providing oxygen to our bodies, while operating at a granular level, managing cell signals and removing invaders.
The main function of our respiratory system - supplying oxygen to our bodies and expelling carbon dioxide - is mostly an automatic process. However, we notice it very quickly when it's not going well – shortness of breath, struggling to exhale, coughing, tiredness, lack of sleep and/or continual waking are some of the symptoms of poor respiratory health.
When we examine closely what happens within the respiratory system, it's astoundingly complex.
Think of the air going through your nose and mouth, through your bronchial tubes and into your lungs (remember it's a swimming pool's worth of air every day) and then think about what else is in that air -we breathe in oxygen and other gases as well as particles of chemicals and matter - like burnt rubber from car tyres, steams and vapours. We also breathe in viruses, dust mites, fungal spores, bacteria and protozoa and occasionally an insect!
Our lungs and bronchial tubes are lined with a layer of cells called the respiratory epithelium. These surface cells have a big job as our first line of defence against the pathogens and foreign particles we breathe in.
When these cells come into contact with invaders, they secrete substances such as mucins, defensins, lysozyme, lactoferrin and nitric oxide. These substances non-specifically shield the respiratory tract from the invaders.
The epithelial cells also produce mediators such as reactive oxygen radicals, cytokines (TNF-α, IL-1β, granulocyte/macrophage colony-stimulating factor [GM-CSF]), and platelet-activating factor which drive inflammatory cells to the site of invasion.
Many of the lungs' epithelial cells have cilia, tiny hair-like structures that help to move mucus and debris out of our respiratory system - these can be damaged in diseases like COPD, so help is needed in moving irritants out of the lungs.

And like the rest of us, our lungs age over time:

- Alveoli (see picture) are tiny air sacs at the end of the bronchioles where oxygen and carbon dioxide are exchanged between the lungs and the blood during the process of breathing; these alveoli can lose their shape and become baggy;
- The diaphragm can become weaker, decreasing our ability to inhale and exhale;
- Ribcage bones become thinner and change shape, altering the ribcage so that it is less able to expand and contract with breathing;
- Nerves in the airways which trigger coughing become less sensitive to foreign particles meaning the particles build up in the lungs and can damage the tissue;
- Our immune system can weaken, leaving us more vulnerable to infections like influenza and pneumonia.



What does a lung disease diagnosis mean?

A diagnosis of a disease explaining poor lung health can be a relief – you knew that something was wrong - but it can also be incredibly worrying.
Medical doctors will be able to prescribe a variety of medicines to improve lung function, depending on what the disease is behind the diagnosis.
Here are some common respiratory diseases:

Asthma - The bronchi and lungs become inflamed and narrow. This is often in response to triggers, such as molds, exercise or air pollution.

Chronic obstructive pulmonary disease (COPD) - where the lungs become inflamed, overproduce mucus and the lining of the lungs become thickened. The alveoli (air sacs) become less efficient at bringing oxygen into the body and sending carbon dioxide out. Narrowing/inflammation of the bronchi in COPD can be permanent, compared with asthma, where it is often temporary.
COPD is an umbrella term for diseases such as emphysema (weakened and ruptured alveoli) and chronic bronchitis, where the bronchi stay inflamed and over-produce mucus, causing constant breathing challenges.
Interstitial lung disease – this is another umbrella term used to describe a number of lung diseases, including sarcoidosis, idiopathic pulmonary fibrosis (IPF), Langerhans cell histiocytosis and bronchiolitis obliterans. For all interstitial lung diseases, the lung tissue becomes scarred, inflamed and stiff. Scar tissue develops in the interstitium which is the space between the alveoli. The scarring can spread making the lungs more rigid and unable to expand, causing dry coughs, shortness of breath and breathing difficulty.
Some autoimmune diseases, like rheumatoid arthritis and lupus have been linked to interstitial lung diseases.

Pulmonary hypertension is high blood pressure in the lungs. Normal blood pressure affects all the blood vessels in the body, but pulmonary blood pressure affects only the blood vessels between the heart and lungs. These vessels are narrowed and sometimes become blocked, meaning the heart has to work harder, increasing the blood pressure in the lung arteries and capillaries.

Cystic fibrosis is a genetic disease that people are born with. It changes the makeup of mucus in the body to be thicker and stickier, with more of it and it can be difficult to cough up. This makes children more prone to infections as bacteria, viruses and fungi. Cystic fibrosis can also affect the digestive system.

Lung cancer is a disease where the cells in your lungs grow abnormally, eventually forming tumours. As the tumours grow, the lungs struggle to function and the cancer can spread to other parts of the body.

We understand at Zestt that lung diseases can be incredibly difficult to live with. There are numerous medical treatments for such diseases, and we urge you to work closely with your doctor and wider medical team to get treatment which works for you.

More on lung scarring

The medical name for lung scarring is pulmonary fibrosis and it's pretty serious – so what is it?

Normally, lung tissue is thin and lacy but when fibrosis occurs, it's like any scars on our body, there is a thickening of the tissue and a reduction in flexibility. This means when breathing, inhaling and exhaling, it's harder for the tissue to expand and contract leading to less oxygen entering the blood stream. With lung scarring a person requires more energy to breathe and the additional energy demand, leads to shortness of breath.

Zestt Wellness co-founder, Darcy Schack (pictured while hospitalised above), describes it as:

"Like trying to breathe through a straw."

There are many known causes of pulmonary fibrosis and unknown causes as well. Exposure to toxins like asbestos, coal dust or silica can be incredibly problematic with tiny particles lodging in the lung tissue itself, causing permanent scarring. Some medications are known to have side effects of pulmonary fibrosis (amiodarone, bleomycin, nitrofurantoin, to name a few). There are also a group of diseases known as collagen vascular diseases which cause pulmonary fibrosis. This group of disease includes systemic lupis, scleroderma, rheumatoid arthritis and Sjogren's syndrome. Lung scarring can also be caused or influenced by our genetic make-up – hereditary diseases.
here are some very interesting scientific papers coming to light which are attempting to alter biochemical pathways associated with pulmonary fibrosis and new antifibrotic therapies approved for treatment to slow down lung function decline,
Increased lung inflammation is also associated with pulmonary fibrosis and there are a number of pharmaceutical and plant-derived natural compounds which have been shown to reduce inflammation in the lungs which can make breathing easier.
Anyone with pulmonary fibrosis should have a treatment plan from their medical practitioner.
To add to that, there are lifestyle changes which can improve ease of breathing, including reducing exposure to toxins, like cigarettes, incrementally increasing exercise and eating an anti-inflammatory diet (see more on page 10).

What is lung inflammation?

There are 2 types of lung inflammation:

1. Acute - in response to a viral or bacterial pathogen, such as pneumonia.
2. Chronic - continued inflammation as seen in asthma and COPD (chronic obstructive pulmonary diseases).

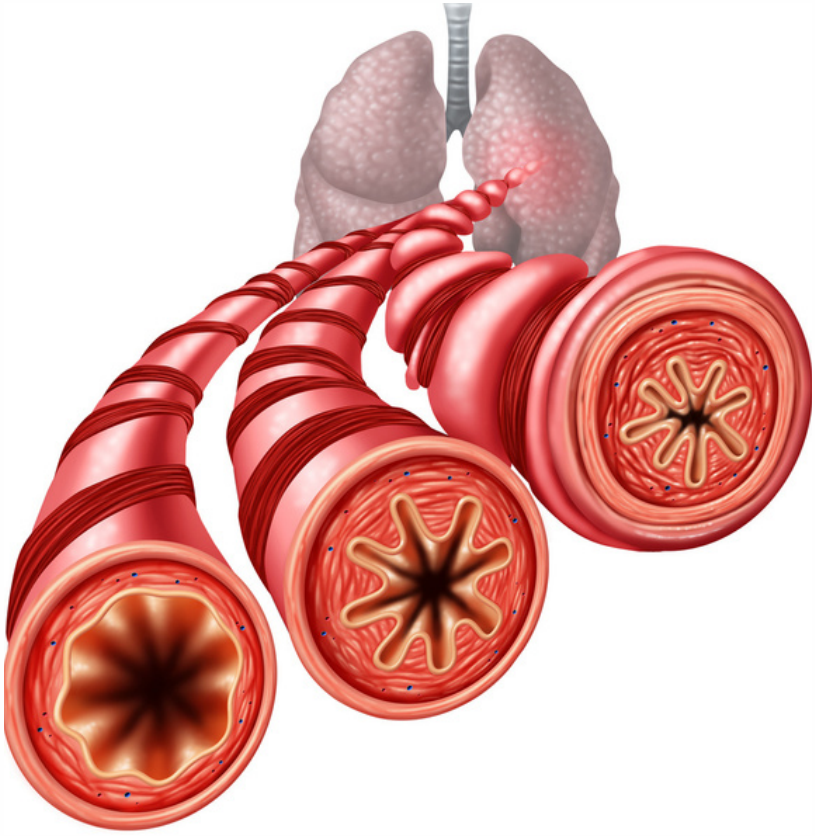
When lungs inflame, it is in response to an multitude of cell signals which are triggered by a pathogen, allergen or damage.

Lungs are constantly exposed to harmful pathogens, so an immediate and intense defence action (mainly inflammation) is required to eliminate the invaders as quickly as possible.

There is a delicate balance between inflammation and anti-inflammation - which is essential for lung homeostasis.

When lungs are chronically inflamed, this balance, or homeostasis, is disrupted and reduced air capacity through lung constriction and excess phlegm can result - causing long-term breathing difficulties.

A reduction in exposure to pathogens and irritants is important in reducing this response - as are finding ways to improve our body's access to "clean-up" molecules.



Stylised image shows three bronchial tubes with differing levels of inflammation - the tube on the right shows how excess inflammation can restrict airflow.

Inspiration for smokers

Let's start by saying, we don't want to sound judgmental - sometimes we eat the wrong foods, take up unhealthy habits and don't exercise enough – we know, we've been there! What we do want to say, is that our bodies are amazing and with the right support (medical and other) we can improve our health, at any age.

To help illustrate this, we want to share the exciting findings from a study led Dr Peter Campbell, a medical doctor and a scientist (and a member of Zestt's Science Advisory team - Peter heads up the Cancer, Ageing and Somatic Mutation Research Group at the Wellcome Sanger Institute in the UK).

In 2020, Peter's group published a study in *Nature* where they found something totally unexpected Link to publication.

If someone is a smoker, many of their cells mutate, but some cells avoid mutation, existing as if they were in "a nuclear bunker." When someone quits smoking, these healthy cells grow and replace many of the damaged cells in the lungs. Basically, our lungs have an almost "magical" ability to repair damage caused by smoking – but only when we stop!

We found this news to be incredibly motivating - it's never too late to start a repair process. There it is, the number one thing to do for improving lung function if you are a smoker is to quit smoking.

What is PM 2.5?

PM2.5 stands for particulate matter that has a diameter of less than 2.5 micrometres. PM2.5 are tiny particles that are >100 times thinner than a human hair. In areas of high PM2.5, the air starts to look hazy, the particles are so light, they stay in the air, distorting our vision clarity (larger particles tend to settle on surfaces).
PM2.5 are a mix of solid and liquid particles which are a result of burning fuel and chemical reactions that take place in the atmosphere. Natural processes such as forest fires can also contribute PM2.5 in the air.

Scientific research shows that extended exposure to PM2.5 is far more serious when it is regular/continuous. For every 10ug/m3 increase in PM 2.5, there are increases in childhood asthma rates and lung and heart disease rates - reviewed here and here.

What can you do to avoid PM2.5? Good air filters in homes and masks when out and about in times of peak traffic are advisable. Also, try to travel and exercise during times where there is less traffic and less PM2.5 in the air - especially if you are already suffering from poor lung health.

Exercise: - a one-size fits all approach may not suit

.

One of the challenges for people with lung disease is that exercise can be incredibly difficult and may exacerbate symptoms of wheezing and coughing.

If you suffer from lung disease, lung scarring and/or reduced lung capacity, it is harder to obtain the gas exchange (oxygen and carbon dioxide) needed for the increased respiratory needs of exercise, as your lungs may not expand as well, or be as elastic as they used to be. This can lead to an impairment of gas diffusion into your blood system and hypoxaemia (low oxygen levels) which can interfere with how your body functions.

So it's really important to listen to your body when starting any exercise programme and to be patient if your progress is slower than you might have hoped for - slow progress is better than no progress!

A "one size fits all" approach to exercise is not a good thing for anyone, especially for someone with a lung disease.

High-intensity exercise is not always the best option either, in fact in one study of patients with lung cancer, researchers showed a moderate level of activity was more beneficial than high intensity exercise (read more here).

Going along to something like a community or gym exercise class can also be discouraging especially if you are comparing yourself to those who have healthy lungs. It's important in designing what increasing exercise looks like for you, that you take into account these factors and design something that is right for you.

Here are some tips to get started:

1. Set realistic goals - this will help you stay motivated and committed to your routine.
2. Start small - start with small, achievable goals, such as taking a short walk or doing some stretching exercises. Gradually increase the intensity and duration.
3. Find activities you enjoy - like dancing, swimming, cycling, or playing a sport.
4. Incorporate incidental exercise - such as walking or cycling to work, taking the stairs instead of the elevator, or doing household chores.
5. Be consistent - try to exercise at least 3-4 times per week.
6. Mix it up - incorporate a variety of different exercises into your routine to keep it interesting and challenging.
7. Listen to your body: if you experience pain or discomfort, reduce the intensity or duration of your workouts or seek advice from a healthcare professional.

How does exercise improve your breathing?

Improved lung function.
Exercise can help improve your lung function by increasing your lung capacity and strengthening your respiratory muscles; this can lead to improved breathing and less shortness of breath.

Increased endurance.
Exercise can help increase your endurance and overall fitness level, allowing you to engage in daily activities with less fatigue.

Reduced risk of exacerbations. Regular exercise can help reduce the frequency and severity of exacerbations in diseases like COPD, which can reduce the need for hospitalisation and other complications.

Better mood and mental health. Exercise is known to release endorphins, which can help improve your mood and reduce symptoms of depression and anxiety.

Improved quality of life.
By improving your lung function, endurance, and overall health, exercise can help you live a more fulfilling life with a lung disease.
Exercise also has great benefits for your immune system, which is critical for those who have chronic respiratory issues. Exercise reduces age-related oxidative damage and chronic inflammation, increases autophagy (cleaning out of damaged cells), and improves mitochondrial function (cellular energy production), and improves cell signaling pathways and insulin sensitivity.

Darcy has poor lung function from his sarcoidosis – he moved house a couple of years ago and has to climb crazy steep stairs every day (he also has an amazing view). He believes that this hard daily exercise has contributed to him improving his lung function and capacity - every bit helps!

Sometimes, it's increasing the little everyday things which can make a difference - walking, gardening, and housework all help improve lung function.

Diet & lung health

Diet can improve lung function. Eating more plants and less processed food is very important for our general health. There are also some super foods for lungs.

In particular, we love anthocyanins for lung health and immunity. Have a read of this article in Medical News Today Link which highlights how anthocyanins can slow lung function decline:

"The research revealed that the highest quartile of anthocyanin consumers, when compared with the lowest, had a much slower rate of decline in all three aspects of lung function measured by the spirometry."

So that means eat as many purple fruit and vegetables as you can.

Boysenberries, black currants, blueberries, grapes, elderberries, aubergines, red cabbage, beetroot, purple kumara and black rice!

In our Zestt Breathe+ lozenges, we incorporate concentrated anthocyanins with other lung healthy natural bioactives - you can check them out here.

There are also plenty of other lung-healthy and anti-inflammatory foods:

Leafy Greens: vegetables like spinach, kale, and collard greens are rich in antioxidants, vitamins, and minerals that help protect against lung damage caused by pollution and other harmful substances.

Nuts and seeds: nuts like almonds and sunflower seeds are rich in vitamin E, which can help protect against lung damage caused by toxins in the environment.

Fatty fish: fish like salmon, tuna, and mackerel are rich in omega-3 fatty acids, which help reduce inflammation and improve lung function.

Garlic: garlic contains compounds that can help protect against lung cancer and reduce inflammation in the airways.

Turmeric: turmeric contains a compound called curcumin, which has anti-inflammatory and antioxidant properties that can help improve lung health.

Ginger: ginger contains compounds that help reduce inflammation in the airways and can help improve lung function.

Everyday household chemicals to avoid

1. Sodium hypochlorite: this is the active ingredient in bleach, which can irritate the lungs and trigger respiratory symptoms.

2. Limonene: this is a common fragrance ingredient found in air fresheners, cleaning products, and laundry detergents. It can cause eye, nose, and throat irritation and trigger respiratory symptoms.

3. Ammonia: ammonia is a strong, irritating chemical found in many cleaning products. It can irritate the eyes, nose, throat, and lungs, and worsen respiratory problems.

4. Sodium hydroxide: this is a corrosive chemical found in some oven cleaners. It can irritate the eyes, nose, throat, and lungs and cause breathing difficulties.

5. Propylene glycol: this is a common ingredient in air fresheners and fabric softeners. It can cause eye and skin irritation and trigger respiratory symptoms.

6. Permethrin: this is a pesticide commonly used to kill insects, like bed bugs. It can irritate the lungs and cause breathing difficulties.

7. Sodium lauryl sulfate: this is a foaming agent found in many cleaning products, including laundry detergents and dish soaps. It can irritate the skin and trigger respiratory symptoms.

8. Formaldehyde is a chemical that is sometimes used in air fresheners - it is a colorless gas with a pungent odor and is highly effective at breaking down and eliminating organic compounds that can cause bad smells, but can also cause respiratory issues.

9. Acetone: this is a solvent found in some cleaning products and nail polish removers. It can irritate the eyes, nose, throat, and lungs and worsen breathing issues.

10. Toluene: this is a solvent commonly found in paint and paint thinners. It can irritate the eyes, nose, throat, and lungs and trigger respiratory problems.

Check out Zestt Breathe+

Breathe+ comes in lozenge and liquid form and have been designed to support lung health and immunity.

The bioactives in Breathe+ are naturally-derived and support respiratory health by reducing inflammation and phlegm build-up and boosting the body's innate immune system.

The bioactives in Breathe+ include:

Anthocyanins (from boysenberries & blackcurrants). Anthocyanins are bioactives that support lung health and immunity by reducing inflammation and supporting a clear respiratory tract. They promote the production of M2 macrophages which help drive the body's innate immune response. Anthocyanins are also good antioxidants, helping the body to clear damaging free radicals.

Quercetin. Quercetin is a flavonoid derived from the flower buds of *Japonica saphora*. Quercetin is a zinc ionophore which means it helps zinc to cross cell membranes promoting a strong immune response. Quercetin is also an excellent antioxidant and has anti-viral properties.

Chelated Zinc. Zinc is critical for a high-functioning immune system. By combining zinc with quercetin, we optimise zinc action within cells. The zinc in Breathe+ lozenges is in a chelated form to be more gentle on the stomach and to promote bioavailability for the body.

BLIS K12 oral probiotic. BLISK12 are a strain of beneficial bacteria from the *Streptococcus salivarius* family that support the health of the beginning of our digestive system. BLISK12probiotics inhibit the growth of detrimental microorganisms, promoting oral microbiome health and immunity.

Dr Anna Campbell

ABOUT

Zestt co-founder, Anna Campbell (PhD, plant biotechnology) has extensive scientific and commercial experience. She is passionate about the value of plants for human health and wants to do all she can to develop efficacious products which counter the negative affects of the pro-inflammatory lifestyles most of us are living.

Anna spent 15 years with AbacusBio, six of those as Managing Director, where she led an international team working in over 20 countries, on food and agricultural programmes. She also holds directorships in New Zealand and international (UK and US) science businesses.

Darcy Schack

ABOUT

Zestt Co-founder, Darcy Schack, suffers from an autoimmune disease known as sarcoidosis. Sarcoidosis is an inflammatory disease that affects multiple organs in the body, but mostly the lungs and lymph glands.

Darcy takes immunosuppressants and as such is keen to develop products which enhance his, and others', health and natural immune system.

Darcy has a background in physics and engineering and extensive food industry experience.