

the ability of sulforaphane to provide measurable benefit across a diverse range of conditions that extend from asthma to atherosclerosis to autism to type 2 diabetes to *Helicobacter pylori* infection to gut mucosal repair to nasal allergy<sup>(1)</sup>.

How does one phytochemical exhibit such a diverse range of effects? Quite simply, because it acts *upstream* to modulate the core cellular functions which include redox balance, uncontrolled inflammation, detoxification, ATP synthesis and others governed by over cytoprotective 200 genes.<sup>15</sup>

### Targeting Immune Signalling

As described earlier, the LTA molecules which form part of the bacterial membrane of probiotic organisms like *Lactobacillus spp.* act as signalling molecules. When LTA docks onto TLR2 on the epithelial cells, it sends signals to the underlying immune network. These signals are simultaneously capable of initiating processes for infection control, modulation of allergy and autoimmune responses.

For this signalling to occur, it is not necessary to supply live probiotic species. A heat-killed microbe such as *Heat-Killed Lactobacillus-137* (HKL-137) standardised for its LTA content has been used in clinical trials to demonstrate its ability to modulate the immune response.<sup>16,17</sup> Such heat-killed probiotics are designated *immunobiotics*. In addition to having a standardised LTA content, immunobiotics are typically heat-stable over several years and are not reactive in those individuals who are intolerant to the histamine content found in many live probiotic cultures.

Intricate feedback mechanisms of the immune system determine when these processes should be ramped up – and when they should be suppressed. In this way, an infectious microbe can be successfully destroyed by a responsive immune system rapidly producing inflammatory cytokines and other destructive molecules. Feedback mechanisms then ‘tell’ the immune system to shut down the inflammatory burst as soon as the

pathogen has been destroyed to avoid damaging the tissues of the host. Failure of such finely-tuned modulatory processes leads to numerous immune-related diseases.

The complexity of these signalling and modulatory processes is such that it is not possible for clinicians to successfully micro-manage these processes. The more logical clinical strategy would be to support the endogenous processes of human cells rather than by directly manipulating the population of resident microbes.

### CONCLUSION

Considering the gut as a *functional ecosystem* expands our understanding of its many functions that impacts both local and distant tissues. More so, when the colonocyte is seen as the driver of gut ecology, the therapeutic possibilities extend into the domain of endogenous defences, providing clinical strategies that can be influenced by evidence-based nutrigenomic interventions.



Jo Duff, Kahikatea Farm

Jo is a passionate plantswoman and educator with a particular penchant for food forests and perennial agricultural systems. She loves to open people's minds to a different way of growing plants. A long time environmentalist and permaculture practitioner, she has spent the last fifteen years teaching permaculture, sustainability and horticulture courses, including teaching medicinal herb growing at Lotus Holistic Centre.

Originally from the UK, her *tūranga-waewae* since 2005 has been Kahikatea Farm in Poukawa, near Hastings. Here she runs a certified organic plant nursery by the same name, which sells (online) over 350 species of culinary and medicinal herbs, edible fruit and nut plants, perennial vegetables, bee plants, dye plants and more.

The sixteen acre farm also features a 2.5 acre food forest, coppicing timber lots, native plantings, a small silvo-pastoral system, home vegetable gardens, a wetlands, and a small off-grid house which is home to Jo, husband Aaron, daughters Anna and Eliza, and their three dogs.

BY JO DUFF

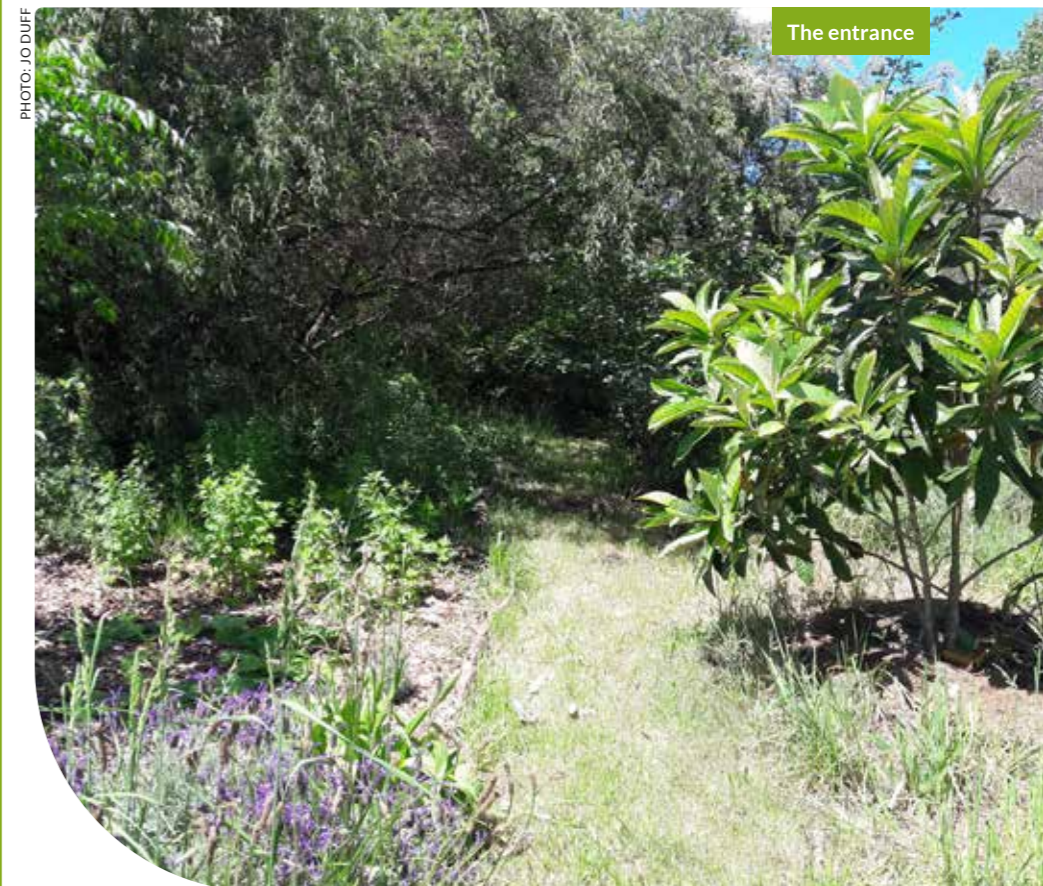
## Growing ‘farm-aceuticals’ – the food forest way

Let me take you on a wee journey. Grab a herbal cuppa and follow me down the hill past the block of coppicing gums underplanted with natives, through the gate built of branches from those gum trees, and into our food forest.

Well, some would call it a food forest, some might call it a forest garden. Either way it is a 2.5 acre formerly bare paddock which we have been planting out over the last thirteen years, aiming to integrate as many useful plants as possible for food, medicine, fuel, fibre and building material, along with the support species required for shelter, pest control, nutrient cycling and attracting pollinators. Instead of having to drive to town, I want that paddock to be my very own Pak’n’Save, my Mitre 10, my “farm-acy” – you get the drift.

Now watch your step as we come down the path to the beehives, around the end of the swale. A swale is a ditch on contour, which acts as a passive rainwater harvesting device. The first rule of water harvesting is to store as much of it in the soil as possible, and we do this by building the humus in the soil which then acts like a sponge. Compost, mulch, biochar, and falling leaves are all ways we add organic matter to the system, which will be turned to humus over time, decreasing the need for irrigating our plants. The second rule of water harvesting is to slow down as much runoff as possible, and we do this with a series of swales. The water sits in the swale and gradually seeps into the downhill bank, passively irrigating the trees, shrubs and herbs planted along it. In our hot dry Hawke’s Bay climate, these are valuable tools to help keep our precious plants hydrated.

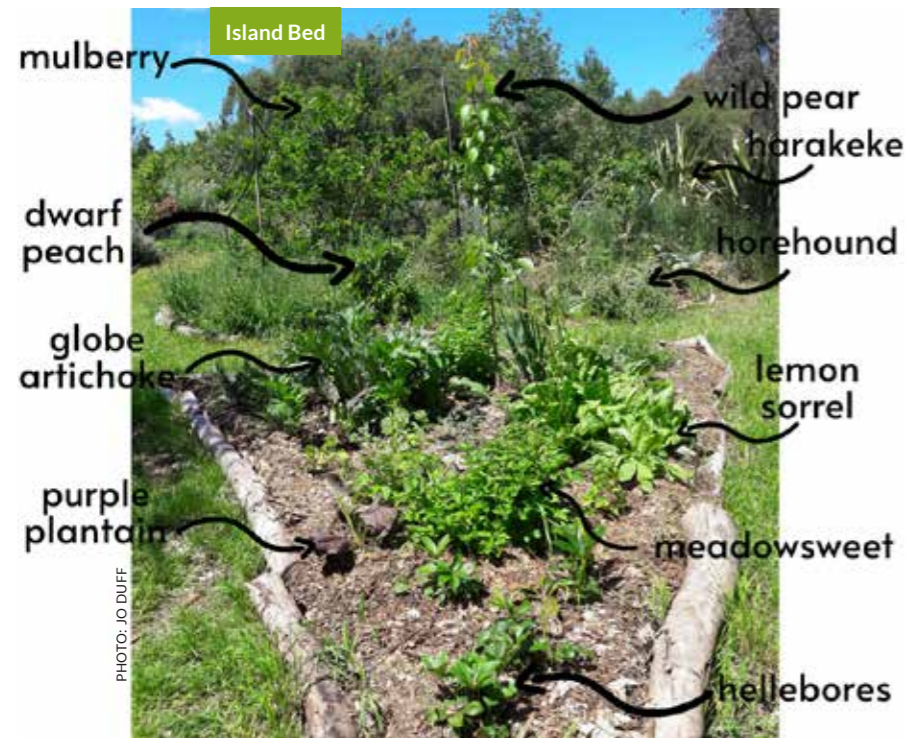
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### REFERENCES

- Hornung B, Martins Dos Santos VAP, Smidt H, Schaap PJ. Studying microbial functionality within the gut ecosystem by systems biology. *Genes Nutr.* 2018;13:5.
- Goto Y, Uematsu S, Kiyono H. Epithelial glycosylation in gut homeostasis and inflammation. *Nature immunology.* 2016;17(11):1244-1251.
- MacDonald TT, Monteleone G. Immunity, Inflammation, and Allergy in the Gut. *Science.* 2005;307(5717):1920.
- O’Neill LA, Golenbock D, Bowie AG. The history of Toll-like receptors - redefining innate immunity. *Nat Rev Immunol.* 2013;13(6):453-460.
- Okumura R, Takeda K. Roles of intestinal epithelial cells in the maintenance of gut homeostasis. *Exp Mol Med.* 2017;49(5):e338.
- Houghton CA. Chapter 14 - The gut microbiome: its role in brain health. In: Ghosh D, ed. *Nutraceuticals in Brain Health and Beyond.* Academic Press; 2021:193-212.
- Minihane AM, Vinoy S, Russell WR, et al. Low-grade inflammation, diet composition and health: current research evidence and its translation. *The British journal of nutrition.* 2015;114(7):999-1012.
- Marchesi JR, Adams DH, Fava F, et al. The gut microbiota and host health: a new clinical frontier. *Gut.* 2016;65(2):330-339.
- Gagliardi A, Totino V, Cacciotti F, et al. Rebuilding the Gut Microbiota Ecosystem. *Int J Environ Res Public Health.* 2018;15(8).
- Leech B, Schloss J, Steel A. Treatment Interventions for the Management of Intestinal Permeability: A Cross-Sectional Survey of Complementary and Integrative Medicine Practitioners. *J Altern Complement Med.* 2019;25(6):623-636.
- Yoon MY, Yoon SS. Disruption of the Gut Ecosystem by Antibiotics. *Yonsei medical journal.* 2018;59(1):4-12.
- Suez J, Zmora N, Zilberman-Schapira G, et al. Post-Antibiotic Gut Mucosal Microbiome Reconstitution Is Impaired by Probiotics and Improved by Autologous FMT. *Cell.* 2018;174(6):1406-1423 e1416.
- Abreu MT. Toll-like receptor signalling in the intestinal epithelium: how bacterial recognition shapes intestinal function. *Nat Rev Immunol.* 2010;10(2):131-144.
- Litvak Y, Byndloss MX, Bäumlér AJ. Colonocyte metabolism shapes the gut microbiota. *Science.* 2018;362(6418).
- Houghton CA, Fassett RG, Coombes JS. Sulforaphane and Other Nutrigenomic Nrf2 Activators: Can the Clinician’s Expectation Be Matched by the Reality? *Oxid Med Cell Longev.* 2016;2016:7857186.
- Hirose Y, Yamamoto Y, Yoshikai Y, Murosaki S. Oral intake of heat-killed *Lactobacillus plantarum* L-137 decreases the incidence of upper respiratory tract infection in healthy subjects with high levels of psychological stress. *J Nutr Sci.* 2013;2:e39.
- Iwasaki K, Maeda K, Hidaka K, Nemoto K, Hirose Y, Deguchi S. Daily Intake of Heat-killed *Lactobacillus plantarum* L-137 Decreases the Probing Depth in Patients Undergoing Supportive Periodontal Therapy. *Oral health & preventive dentistry.* 2016;14(3):207-214.
- Hill C et al. Expert consensus document. *Nat Rev Gastroenterol Hepatol.* 2014 Aug;11(8):506-14.





There now, opposite the beehives you see the latest 'island bed' I've created, in the middle of a clearing. As the centrepiece I have a wild pear tree, climbing up it is a boysenberry, and underneath are planted many herbs. It's almost August and the *Helleborus spp* (Hellebores) are starting to flower. I love these recent additions to our food forest as a source of winter bee food, but I certainly have no intention of using them medicinally – they are extremely toxic, containing cardiac glycosides which have a similar action to *Digitalis spp* (Foxgloves). In any case I am not a trained herbalist at all, I am a plants woman, and although our nursery, Kahikatea Farm, sells the widest selection of medicinal herb plants in the country, I certainly never offer advice to others on the medicinal merits or otherwise of the plants. **Please bear that in mind as we continue our tour and know that any mention of medicinal uses I make is gleaned from my ever growing pile of books on herbs, and a few trusted websites.**

Along with the *Helleborus spp* in this bed we have some other favourites of mine which have become stalwarts in our food forest over the years due to their perfect suitability to our climate. Among these is *Sanguisorba minor*, (salad burnet) a cucumber flavour

salad leaf plant, which is happy in full sun right through to full shade. I harvest a few leaves into my basket. The plant is also a good nutrient cyclor, pulling nutrients through its extensive root system into its leaves and as they die down adding them to the topsoil. It also has medicinal uses – both the root and the leaves are astringent, diaphoretic and styptic, though the root is said to be most active. An infusion can be used in the treatment of gout and rheumatism and also as a soothing treatment for sunburn or eczema<sup>1</sup>.

It is *Sanguisorba officinalis* (Greater Burnet), the larger cousin of *Sanguisorba minor*, which is more noted for its medicinal virtues, in particular its astringent action, but this smaller leaved cousin has many additional uses too. We're currently building up our stocks of this plant in the nursery but have yet to plant any out. It is native to damp meadows and stream sides and we can't yet supply it with its favoured conditions.

Other favourite plants in this bed are *Rumex acetosa* (Lemon sorrel) and *Cynara scolymus* (Globe artichoke). Both act as nutrient cyclers like *Sanguisorba officinalis* (Salad burnet). *Rumex acetosa* is known as salad (or garden) sorrel, and is a clump for-

ming plant which provides lush salad leaves through winter and into early spring. Care should be taken not to eat large quantities due to its oxalic acid content, and I am particularly mindful of this due to my osteoarthritis, but I harvest a large handful of leaves into my basket as the kids love it. I have started planting out one of its relatives, *Rumex acetosella* (Sheep's Sorrel), as a ground cover in a different area, to take advantage of its spreading rather than clumping habit. *Rumex acetosella* is a detoxifying herb, the fresh juice of the leaves apparently having a pronounced diuretic effect, but I haven't eaten much of it as the leaves are small and a bit fiddly to harvest so I can't attest to this. Its main claim to fame is as one of the ingredients in the hotly debated Essiac tea.

The last plant I want to show you before we move on is *Filipendula ulmaria* (Meadowsweet), which I am excited about because it has done so much better than I thought it would – its preferred habitat is damp marshes and bogs, and here we have it thriving in part shade at the edge of a patch of *Eucalyptus globulis* (Eucalyptus) trees! Maybe the *Sanguisorba officinalis* (Greater Burnet) does stand a chance after all! I have to admit to never having tried the *Filipendula ulmaria* but I am certainly keen to harvest the leaves and flowers this coming season to make a tea – it's said to be sweet and refreshing. It has a long history of herbal use and was apparently one of the three most sacred herbs of the Druids. The leaves and flowering stems are alterative, anti-inflammatory, antiseptic, aromatic, astringent, diaphoretic, diuretic, stomachic and tonic<sup>2</sup>. The



flowers contain salicylic acid, but rather than being an irritant to the stomach lining, they are protective and anti-inflammatory<sup>3</sup>.

Now let's move on towards a more shaded area on the south side of a hill. First, on the sunny edge we have *Eriobotrya japonica* (Loquat), whose leaves we use fresh or dried to make a tea (after rubbing the hairs off first). The leaves have analgesic, antibacterial, antiemetic, antitussive, antiviral, astringent, diuretic and expectorant properties<sup>4</sup>, and they are currently helping us battle our second round of winter ills. There is also *Leptospermum scoparium* (Manuka), whose benefits I'm sure you don't need reminding of, and *Sambucus nigra* (Elder), also well known as an all-round 'medicine chest', and then a *Crataegus pinnatifida* (Chinese hawthorn). The latter is a hardy deciduous shrub, which we have planted out in various other spots too – it's very easy to grow as it is tolerant of most soils and sites including extremes of very wet and very dry, strong winds and atmospheric pollution.

With various species indigenous to countries across the northern hemisphere, *Crataegus spp.* have a long-recorded history of medicinal use in Europe, China and North America. *Crataegus monogyna* (Common Hawthorn) is one of the best known plants in western herbalism, the flowers, leaves and fruit are all used and have a specific action on the heart. The *Crataegus pinnatifida* variety that we have growing produces fruits up to 20mm in diameter and have acid-sweet flesh reminiscent of a slightly mealy apple. They can be eaten raw, cooked, or dried, and alone or blended with other fruit, and can be processed into jams, jellies, wines, fruit leathers etc. Our kids love harvesting them, they eat them like tiny apples and fill up their lunch boxes with them!

Looking down to the ground cover under these trees we see useful herbs like *Symphytum x*

*uplandicum* (Russian comfrey) and *S. Grandiflorum* (Evergreen comfrey), *Melissa officinalis* (Lemon balm), and *Teucrium scorodonia* (Wood germander), the latter another in our armoury to fight winter chills (make a tea from the fresh or dried leaves). The bees will also thank you for planting all these herbs. Oh yes and mind the spiky *Leonurus cardiaca* (Motherwort) stems, there's a big patch of them here, I meant to cut them back earlier in the season. They do tend to scratch you and catch in your clothing, but it is a lovely herb to grow otherwise.

So, into the full shade we go, cast by nitrogen fixing trees such as *Chamaecytisus proliferus* (tagasaste/tree lucerne) and *Alnus cordata* (Italian alder). We wind our way uphill past *Amelanchier canadensis* (Canadian Serviceberries) with their summer berries rich in iron and copper, and the bark of the trunk and roots used for medicinal purposes by the indigenous peoples of the north American regions the serviceberries call home<sup>5</sup>. *Arthropodium cirratum* (Rengarenga lilies) and more *helleborus spp.* are our ground covers of choice here. The former was used medicinally by Maori as poultices and the root is also edible – it was traditionally cooked in a hangi. I think I'll stick to kumara, but I do prefer to plant something



that is at least nominally edible rather than not.

Then we pop out into the sun again at the top of 'Peach Tree Hill' with its various varieties of standard and dwarf peach and nectarine trees. It's very hot and dry up here and the plant choices reflect that, with the bulk of them heralding from Mediterranean climes. There are lots of *Cynara scolymus* (Globe artichokes) and *Cynara cardunculus* (Cardoons), *Rosmarinus officinalis* (Rosemary), *Salvia officinalis* (Sage), and *Cistus spp* (Rock rose species). Both *Cynara scolymus* and *Cynara cardunculus* contain cynarin which has aroused great interest for its medicinal use to improve liver and gall bladder function and treat related complaints<sup>6</sup>. The globes

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are one of our favourite vegetables and are such a treat in spring dipped in garlic butter! The *Cistus spp.* also have strong medicinal properties, being anti-viral, anti-bacterial and anti-fungal, helping to treat issues such as staphylococcal infections and candida <sup>7</sup>.

The Mediterranean species are accompanied by a few Californian bedfellows such as *Ceanothus spp* and one of my favourites, *Salvia mellifera* (Black sage). The leaves of this plant are strongly aromatic and are said to have carminative and cardiac properties <sup>8</sup>. Back at the bottom of the hill, past the *Zanthoxylum spp* (Szechuan pepper trees), traditionally used to treat ailments as varied as toothache and malaria <sup>9</sup>, are more Californian friends – *Eschscholzia californica* (Californian poppies). Some would call them enemies – they can be weedy in some parts of Aotearoa, but I am happy for them to self-seed here, they never seem to go too far, and their cheery orange flowers belie their medicinal value as a calming herb to treat insomnia and nervous agitation <sup>10</sup>.

Also, self-seeding along this stretch is *Galium aparine* (Cleavers), not a plant which I have ever purposefully planted out, but one which I am nonetheless happy to harvest. The tips of this herb go into my basket

along with the other salad leaves we've plucked along the way. Whilst I thank the plant for its offering now, I know that I will be cross with it later in spring when it climbs rampantly all over the other herbs and shrubs, forming a blanket of scratchy scrambling stems which cause skin irritations when you try to pull them out. Ironic then that one of its many uses is to treat psoriasis <sup>11</sup>. Most likely, as usual, I'll be too busy in the nursery in spring to keep on top of the weeding in the food forest and it will go right through to seeding stage and therefore will be even more rampant next season. Although I have read that, being of the same botanical family as coffee, the seeds can be roasted to make a passable caffeine-free substitute <sup>12</sup>. I'd love to see what the reaction is from the nursery staff when I serve that up for morning coffee!

Another welcome weed is *Malva sylvestris* (Mallow). We pick some tender leaves and pop them in the basket. If I had a pair of shears with me, I'd chop down the rest of the plant to mulch its neighbours and thank it for its multi-functional uses. It will be back in a few weeks to provide me with another harvest. I do use the small leaves in salads but bigger leaves get chopped and added to stir fries and stews. They are highly nutritious, being extremely high in vitamins A, B

and C, as well as calcium, magnesium and potassium. They have a mucilaginous texture and their demulcent properties make them valuable as a poultice for bruises, insect bites etc. They can also be taken internally for respiratory issues and are said to combine particularly well with *Eucalyptus globulis* to treat coughs <sup>13</sup>.

Anyway, onwards we go again round the base of the hill, to a lovely north-facing spot, sheltered from the cold winter southerlies. Here we have terraced the hillside (another water harvesting technique where the terrain is too steep for swales) and planted many citrus varieties, interspersed with more tree lucerne, various acacia species, and *Cordyline australis* (Ti Kouka/cabbage trees) to provide a bit of canopy. In the herbal layer we find more drought hardy species – medicinal herbs such as *Marrubium vulgare* (White horehound), various *Thymus spp* (Thymes), and *Phlomis fruticosa* (Jerusalem Sage). Also here is another favourite salad plant, *Centranthus ruber* (False valerian), with its crisp, crunchy leaves. We have both red and white forms, and the flowers are great for attracting butterflies.

Onwards from the citrus we have apricots, medlars and more loquat trees, and also a chook run. The chooks are busy preparing the ground for the next round of understorey planting. We collect a few eggs in the basket, then turn back around towards the swale we first came across and from this view you see that the bank is planted with many species of apples, pears, plums, damsons and prunes, with quinces and *Japonicas* on another swale below it. Out of sight down in the swale ditch itself you'll also find various *Metha spp.* (Mints), as it's shady and moist, which keeps them happy.

You also now notice the little wattle and daub hut which snuggles in against the backdrop of trees. This was a lockdown project started by my kids, which is still not quite finished but is already a thing of beauty. Made using resources almost entirely from the food forest, and with the



help of many friends and community groups, it has become a focal point, and will provide a space for meditation, rest, play and socialising. It's not only herbs which can give medicinal value, but this little whare, along with a bench sitting atop Peach Tree Hill, are places which I am drawn to,

to take a little time out, and just take a deep breath or two.

Behind the hut is another new island bed joining three fruit trees, containing mostly perennial vegetables. Some are of the 'plant 'em once and harvest forever' kind, such as the

ubiquitous *Rumex acetosa* (Lemon sorrel), *S. officinalis* (Salad burnet) and *C. Scolymus* (Globe artichokes). Others are more short lived perennials or self-seeding biennials such as *Diplotaxis tenuifolia* (Arugula), *Brassica oleracea* (Collards), *Barbarea verna* (Land cress), and *Brassica oleracea var acephala* (walking stick kale) which grows up to 2m tall on a trunk and looks like something out of Dr Seuss! I'm fond of growing perennial vegetables, not just for the amazing return on investment they provide (in terms of time and work to harvest ratio), but also as they tend to be more nutritious, getting their roots deeper and accessing more minerals. So a selection of all these leaves gets added to my basket.

I think we have a pretty good base for a salad and an omelette now, don't you? So let's head back up to the house for lunch. Later I might take you down to our certified organic nursery to show you the rest of our range...or maybe we'll just wander back down to the little whare with a herbal brew and chill out. We deserve it!

REFERENCES

- Grieve A. Modern Herbal. Penguin,1984. Cited on <https://pfaf.org/user/plant.aspx?LatinName=Sanguisorba+minor> [cited 2021 Jul 22]
- Grieve A. Modern Herbal. Penguin,1984; Launert. E. Edible and Medicinal Plants. Hamlyn 1981; Lust. J. The Herb Book. Bantam books, 1983, and Mills. S. Y. The Dictionary of Modern Herbalism. Healing Arts Press, 1985. Cited on <https://pfaf.org/user/Plant.aspx?LatinName=Filipendula+ulmaria> [cited 2021 Jul 22]
- Chevallier. A. The Encyclopedia of Medicinal Plants. London: Dorling Kindersley, 1996 cited on <https://pfaf.org/user/Plant.aspx?LatinName=Filipendula+ulmaria> [cited 2021 Jul 22]
- Chiej. R. Encyclopaedia of Medicinal Plants. MacDonald, 1984; Brooklyn Botanic Garden Oriental Herbs and Vegetables, Vol 39 No. 2. Brooklyn Botanic Garden, 1986; A Barefoot Doctors Manual. Running Press, Yeung. Him-Che. Handbook of Chinese Herbs and Formulas. Institute of Chinese Medicine, Los Angeles, 1985; Duke. J. A. and Ayensu. E. S. Medicinal Plants of China. Reference Publications, Inc., 1985; Medicinal Plants in the Republic of Korea. World Health Organisation, Manila, 1998. Cited on <https://pfaf.org/User/plant.aspx?latinname=Eriobotrya+japonica> [cited 2021 Jul 22]
- AIHDP. Foods Indigenous to the Western Hemisphere – Serviceberry. [Internet] American Indian Health and Diet Project [cited 2021 Jul 22]available from <https://aihd.ku.edu/foods/serviceberry.html>
- Granstrom Jordan. K, M.D. Artichoke. Life Extension. [Internet] Life Extension The Science of a Healthier Life [cited 2021 Jul 22] available from <https://www.lifeextension.com/magazine/1999/7/report3>
- Christiansen. L. Cistus – A Natural Antibiotic, Antiviral and Biofilm Buster. *ProHealth.com* 2019 Apr 24 [Internet] ProHealth [cited 2021 Jul 23]available from <https://www.prohealth.com/library/cistus-a-natural-antibiotic-antiviral-and-biofilm-buster-6292>
- Moerman. D. Native American Ethnobotany Timber Press. Oregon, 1998 cited on <https://pfaf.org/User/Plant.aspx?LatinName=Salvia+mellifera> [cited 2021 Jul 22]
- Snyder. C. What is Prickly Ash and does it have its benefits? [Internet] Healthline [cited 2021 Jul 23] available from <https://www.healthline.com/nutrition/prickly-ash>
- United States Department of Agriculture. Sedatives. [Internet] US Forest Service [cited 2021 Jul 23] available from [https://www.fs.fed.us/wildflowers/ethnobotany/Mind\\_and\\_Spirit/sedatives.shtml](https://www.fs.fed.us/wildflowers/ethnobotany/Mind_and_Spirit/sedatives.shtml)
- Whelan. R. Cleavers. [Internet] Herbs from A-Z [cited 2021 Jul 23] available from <https://www.rjwhelan.co.nz/herbs%20A-Z/cleavers.html>
- Sich.J. Cleavers. [Internet] Julia's Edible Weeds [cited 2021 Jul 23] available from <http://www.juliasedibleweeds.com/general/cleavers/>
- Chevallier. A. The Encyclopedia of Medicinal Plants. London; Dorling Kindersley:1996. Cited on <https://pfaf.org/user/Plant.aspx?LatinName=Malva+sylvestris> [cited 2021 Jul 23]