

FROM LAB TO LUNCH

BASIL

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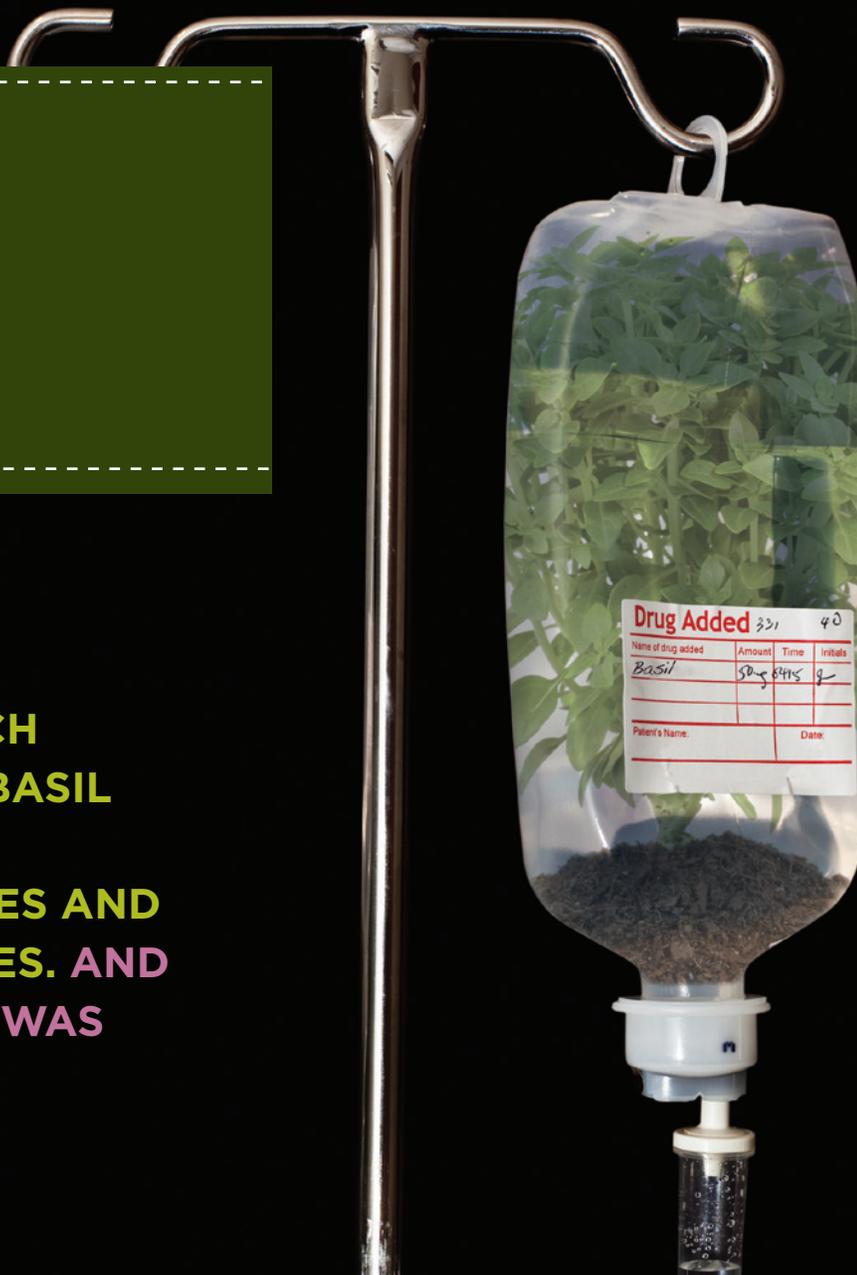
RECENT RESEARCH SUGGESTS THAT BASIL CAN HELP FIGHT BACTERIA, VIRUSES AND CHRONIC DISEASES. AND YOU THOUGHT IT WAS JUST FOR PESTO!

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Basil (*Ocimum basilicum*), an aromatic herb belonging to the mint family, is perhaps best known as the key ingredient in pesto – that savoury Italian sauce made from olive oil, garlic, crushed pine nuts and loads of fresh basil leaves. The type of basil used in Mediterranean cooking – Italian large-leaf – pairs well with tomato flavours and consequently appears in a wide range of dishes from Caprese salad to marinara sauce. Other common basil varieties like sweet, lemon, Thai and holy basil are used judiciously in Thai, Vietnamese and In-

dian cuisine. There are more than 40 cultivars of this pungent plant, each with its own characteristic colour and aroma. Depending on the variety, basil can be green, white or purple with a scent reminiscent of lemon, cloves, cinnamon, anise, camphor or thyme. Some non-edible kinds are cultivated for ornamental purposes or to ward off garden pests.

But it is basil's medicinal properties, rather than its culinary value, that extend the herb's uses far beyond the humble pesto. Like other aromatic plants, basil contains essential oils



EVEN THOUGH BASIL HAS BEEN USED THERAPEUTICALLY FOR MANY YEARS, ARE ITS HEALING PROPERTIES SIMPLY HEARSAY OR **HAVE THE HERB'S HEALTH EFFECTS BEEN SUBSTANTIATED BY MODERN SCIENCE?**

and phytochemicals in the leaves, stem, flowers, roots and seeds that have biological activity in the body. Throughout history, ancient cultures have used herbal remedies to prevent and treat illness and disease. Basil is just one example of the wide range of medicinal flora historically used in plant-based tinctures, compresses, syrups and ointments.

For instance, holy basil (known as *tulsi* in Hindi) has been used for centuries in Ayurveda, a traditional Indian system of medicine, as a treatment for gastric, hepatic, respiratory and inflammatory disorders as well as a remedy for headache, fever, anxiety, convulsions, nausea and hypertension. (See Kyra de Vreeze's article "Holy... Tulsi!", elsewhere in this issue.) Fresh roots and leaves of holy basil were prepared as a tea, or sometimes as a topical treatment to speed wound healing. There is also evidence that traditional Chinese medicine used basil. (See Paul O'Brien's article on TCM and basil, elsewhere in this issue.)

Even though basil has been used therapeutically for many years, are its healing properties simply hearsay

or have the herb's health effects been substantiated by modern science?

From garden to medicine chest

In recent years increased scientific interest in plant phytochemicals (plant chemicals) has brought numerous vegetables, herbs and spices – including basil – to the forefront of nutritional research. Although the study of plant compounds is not new, scientists are only now beginning to characterize the wide range of biologically active components in our food plants and investigate their impact on human health and disease. In cell culture and animal studies basil has been found to exhibit antimicrobial, anti-inflammatory, anti-diabetic, antioxidant and anti-cancer activity.

But how does basil – which nowadays is used as little more than a cooking herb – defend our bodies against chronic disease and illness?

Antimicrobial properties

The first clue suggesting that basil is more than just a garnish is its pungent scent and strong flavour. The volatile chemical compounds respon-

sible for these appealing culinary characteristics also play a role in its biochemical activity.

Volatile compounds are light-weight, organic compounds that give herbs and other plants their potent aroma. In aromatic herbs such as basil these compounds are found in the form of essential oils, complex molecules that differ in chemical structure from plant to plant. By definition, volatile essential oils are hydrophobic (non-water-soluble) in nature and light enough to travel through the air as small droplets (vapour) to our olfactory system, where they stimulate our sense of smell.

Basil contains dozens of aromatic essential oil components in its leaves that vary in quantity and proportion depending on the cultivar. These include eugenol, linalool, estragole, limonene, citral, methylchavicol, and methyl cinnamate. The more distinctly scented varieties boast a predominant volatile compound that out-competes the rest, producing a characteristic aroma.

Lemon basil, for instance, contains mainly citral and limonene, while

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camphor basil has high concentrations of – you guessed it – camphor. Italian large-leaf basil, the kind we associate with the traditional basil smell, acquires its odour from a combination of linalool and methyl chavicol.

In nature these compounds defend the herb from hungry insects and invasive bacteria and fungi. It is no surprise, then, that they can help protect us.

In cell culture studies, basil essential oils have demonstrated potent antimicrobial activity, likely inhibiting bacterial growth by degrading bacterial cell walls and inducing cell lysis (bursting). Extracts of linalool, methyl chavicol and methyl cinnamate, a derivative of cinnamic acid which gives cinnamon its flavour and aroma, among others, inhibit the growth of disease-causing bacteria such as *Staphylococcus aureus*, *Streptococcus faecalis*, *Escherichia coli*, *Shigella* species, *Salmonella* species, *Mycobacterium* species and *Pseudomonas aeruginosa*. Pathogenic strains of these bacteria can cause illnesses like food poisoning, urinary tract infections, pneumonia and dysentery.

Basil is also a known antiviral, anti-fungal and insecticidal agent. Although basil has long been used to treat such bacterial infections, there is not enough scientific evidence to fully support its safety and efficacy in humans.

Inflammation

Another way basil can benefit health is through its anti-inflammatory activity.

Acute inflammation is a normal, protective process that helps the body to cope with infections, immune reactions and tissue injury. But in some cases inflammation occurs chronically and systemically (affecting the whole body), which can be detrimental to

health. This is not only important for the treatment of autoimmune diseases such as rheumatoid arthritis, but also for cancer and cardiovascular disease which involve inflammatory processes.

Most anti-inflammatory drugs are derived from plants, so it is not surprising that an herb like basil, which has been used for centuries to treat inflammatory disorders, possesses similar properties. Basil extracts reduce inflammation by inhibiting the release of pro-inflammatory cytokines (like TNF- α and IL-1 β) and mediators (most importantly nitric oxide).

Cytokines are proteins that are secreted from one cell in our bodies to another, allowing for direct cell-to-cell communication. Specific cytokines help initiate and regulate the inflammatory process. Similarly, nitric oxide, a chemical involved in various cell signalling reactions, helps orchestrate numerous steps in the inflammatory cascade. Thus, blocking the action of these two kinds of substances means blocking the communication and/or orchestration of inflammatory processes.

Disruption of this cascade can be useful in treating inflammatory diseases. This is a promising finding in the case of basil and other dietary herbs. Although these results are hopeful, more human-level research is needed before any solid recommendations can be made for the use of basil as an anti-inflammatory agent.

Diabetes and cardiovascular disease

Basil extracts may also influence the development of two other major diseases currently affecting an enormous proportion of North Americans: diabetes and heart disease. Basil essential oils have been shown to lower blood glucose, triglyceride and cholesterol levels. Each of these has tremendous

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clinical implications.

Glucose, the main nutrient used by cells, is obtained from the digestive breakdown of food and is delivered to cells through the bloodstream. The pancreas secretes a crucial player involved in glucose delivery – insulin – to help regulate this movement of glucose into cells. Insulin’s primary job is to transport glucose into cells so that it can be used or stored. When blood glucose is high, the sugar itself can damage the body; in addition, the body keeps releasing insulin in an attempt to control blood sugar levels. Both high blood sugar and high insulin can do damage.

High blood glucose is a marker for diabetes, a chronic disease characterized by an impaired ability to produce or utilize insulin. Type 2 diabetes is more prevalent than type 1; type 2 diabetics can manage their condition through medication and, more importantly, through dietary and lifestyle modifications. With all of these lifestyle diseases, it’s important to keep circulating glucose levels under control – both to prevent the harmful consequences of high blood sugar, as well as high levels of insulin as the body attempts to deal with blood glucose running amok.

This is where basil and other glucose-lowering agents come into play. Holy basil in particular has been found to reduce circulating glucose levels in both normal and diabetic laboratory animals as well as in diabetic humans. These results, particularly the evidence from human experiments, are hopeful and add credibility to the medicinal use of basil in ancient cultures. Although it is unclear which active compounds are responsible for basil’s anti-diabetic effects, researchers think its essential oils are involved.

Basil’s triglyceride- and cholesterol-lowering properties also offer promise for preventing cardiovascular disease. The combination of high circulating triglycerides (a form of fat in the blood) and LDL cholesterol (the “bad” kind that can clog blood vessels) are risk factors for atherosclerosis, heart attack and stroke. In an experiment in rats, sweet basil extracts hindered platelet aggregation (the clumping together of blood platelets to form a clot) and thrombosis (the actual formation of the blood clot), suggesting the potential for heart attack and stroke prevention. Although the research is still preliminary, basil shows therapeutic potential for cardiovascular disease prevention and treatment.

Antioxidants and cancer

Of all of basil’s health-promoting attributes, its ability to inhibit cancer is the most heavily researched and probably the most interesting. By now it is common knowledge that a diet high in fruits and vegetables and low in animal-based foods contributes to a significant reduction in cancer risk. But how exactly does this occur, and where does basil fit in?

Although there is some debate, scientists generally believe antioxidants have something to do with it. In the case of basil, antioxidants (e.g. vitamins and phytochemicals) contribute to the herb’s ability to prevent cancer.

Phenolics, a group of organic compounds found in tea, herbs, fruits and vegetables, account for the majority of basil’s antioxidant properties. The predominant subtype of phenolics found in basil is the flavonoids, which include vicenin, orientin, eugenol and anthocyanins. Anthocyanins, in particular, are responsible for the deep red-violet pigmentation of purple basil, while eugenol is a component of the essential oils. Because of their anthocyanin content, of all the cultivars purple basil packs the most antioxidant-rich punch: they contain up to 126 milligrams of total phenolics per gram of plant material, roughly

half the amount found in green tea. This is notable since green tea is known to be one of the richest dietary sources of phenolic compounds.

Due to their antioxidant properties, phenolics are currently a hot topic in health research and are thought to play a large role in the anticancer effects of many edible plants. Antioxidants work by protecting cells from damage by reactive oxygen species (ROS), which are oxygen-derived molecules generated by natural chemical reactions in the body. Although ROS are normally occurring, these molecules – if not neutralized properly – can accumulate in the body and contribute to lipid peroxidation (cell membrane damage) and DNA breakage.

DNA, formed from long strands of proteins containing genetic information, is essential for normal cell functioning. It constantly dis-assembles and re-assembles itself as part of the cells' regular processes. Because there's so much complicated stuff to keep track of, DNA can often mis-assemble itself in the day-to-day operation of cells, especially if it gets knocked off track by things like chemicals, radiation or these ROS. Luckily, DNA can also usually fix itself if something goes wrong.

However, more severe damage such as a strand break or compromised repair system can cause irreversible harm. When we have high circulating levels of ROS without enough antioxidants to counter them, DNA has a much harder time keeping things under control. When this happens, the cell will often proliferate uncontrollably and resist normal cell death (apoptosis). Cells' uncontrolled reproduction and failure to go quietly into that good night are hallmarks of tumour initiation and the early stages of cancer.

ROS are also involved in other

conditions like cardiovascular disease, inflammatory disorders and liver disease. The good news is that dietary antioxidants are like nature's house-keeper: they can protect us by scavenging ROS and preventing DNA damage before it starts.

Along with antioxidant phenols, basil is also a good source of antioxidant vitamins A, C and E, all of which have been shown to inhibit cancer through similar mechanisms. Overall, basil is a promising source of antioxidants and the evidence for its anticancer activity is optimistic thus far. As with other supplements and natural health products, future research should be conducted to establish basil's safety, efficacy and possible side effects. But one thing is for certain: behind basil's unassuming leaves lies a plethora of pharmaceutical products waiting to be tapped.

Whatever your tastes and preferences, basil can be a welcome addition to your kitchen, adding flavour and personality to dishes while providing an added health boost.

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How to benefit from basil

So how much basil does one have to consume to reap the health benefits? Researchers have not established an exact amount, but it is worth noting that herbs and spices contribute significantly to the total antioxidants obtained from the diet. Basil is virtually calorie-free and, in addition to antioxidant vitamins and phenolics, is a rich source of vitamin K, zinc, calcium, magnesium, potassium and

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dietary fibre. It adds a lot of flavour in a way that's waistline-friendly.

Introduce basil into your meal plan by flavouring dishes with chopped fresh basil instead of cream-based sauces, cheese or salt. Add a few leaves and a drizzle of balsamic vinaigrette to spice up boring greens, or stick to the classic tomato-basil combo and toss in a handful of chopped basil to pasta sauce, Mediterranean-style pizza or tomato-mozzarella salad. For an Eastern flair, stir a few coarsely chopped Thai

basil leaves into spicy curries, soups or stir-fries until just wilted.

If you can't decide between dry versus fresh, opt for the latter whenever possible – much of basil's health benefits (not to mention flavour and aroma) come from the antioxidant compounds and essential oils that are mostly lost during the drying process. Other options are basil teas and oils, which can be found in health food stores, although the scientific evidence for its efficacy in these forms is limited.

Whatever your tastes and preferences, basil can be a welcome addition to your kitchen, adding flavour and personality to dishes while providing an added health boost. And who knows – given the direction research is headed, basil may one day appear in spice racks and medicine cabinets alike. Pesto, anyone?

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