Before we can truly appreciate the magic that echinacea exerts on enhancing and balancing immune function, we must understand some of the key “players” in the immune system. With such an understanding, you will discover that echinacea can exert a broad-spectrum of effects on the immune system thanks to its various active components affecting different aspects of immune function.
The immune system is the body’s chief defense system. It is beautifully designed to protect the body against foreign attackers such as germs, viruses, bacteria, and other creatures generally known as pathogens. The human immune system is composed of the lymphatic vessels and organs (thymus, spleen, tonsils, and lymph nodes), white blood cells, specialized cells residing in various tissues, and specialized proteins in the blood.

White blood cells are the foot soldiers of the immune system. There are two main types of white blood cells: granulocytes and lymphocytes (-cyte means “cell”).

Granulocytes are so called because they contain granules, or tiny sacs, that store chemicals. Granulocytes engulf and destroy bacteria, cancerous cells and dead particles by releasing enzymes from their granules that break the particle into smaller harmless parts.

Lymphocytes are a type of white blood cell that does not “eat” the invaders. Instead their strategy is to disable them with special destructive chemicals. Lymphocytes play a central role in fighting viral infections and cancer.
Echinacea and the White Blood Cells

Echinacea exerts multiple effects on white blood cell function. Remember echinacea’s historical use as a “blood purifier”? Well, nowadays, we know that the body’s chief garbage collection and elimination system is part of the immune system called the reticuloendothelial system. (Whew! That’s a mouthful.) Let’s call it the RES. The RES comprises white blood cells in the spleen, lymph nodes, liver, bone marrow, lungs and intestines.

The RES is designed to purify the blood indirectly by filtering lymphatic fluid—a fluid that contains primarily waste products from cellular activity—as it passes through the lymph nodes. Lymph nodes are small, soft, bean-shaped nodules clustered in various parts of the body, such as the neck, armpit, and groin. Lymph nodes are connected via lymphatic vessels that run parallel to our blood vessels. Lymph fluid flows through a lymph node in one direction, so that the fluid leaving the node is always cleaner than the fluid that enters it.
The lymph nodes and other components filter lymph by calling on special white blood cells called macrophages, Latin for “big eaters.” These large and apparently hungry cells engulf and destroy particles such as old blood cells, bacteria, viruses and even cancer cells through a process known as phagocytosis. Another type of white blood cell capable of phagocytosis is called a neutrophil.

Macrophages are found throughout the body, especially in the liver, spleen and lymph nodes and macrophages that circulate in the blood are known as monocytes. The macrophage is so important to the RES, that this garbage collecting and eliminating system is also known as the monocyte-macrophage system.

“Swollen Glands?” The Lymph Node vs Infection Phenomenon

When foreign materials are recognized in the lymph fluid, the lymph nodes enlarge as they produce and supply additional white blood cells to help fight infection. During an infection, the nodes are working overtime to collect and destroy infectious agents. That’s why they often swell when an infection starts to attack.
Echinacea to the Rescue!

One of the key ways echinacea enhances immune function is by stimulating the ability of macrophages to engulf and destroy particles.\textsuperscript{1,6-8} By enhancing the activity of these “garbage collectors” of the body, the blood is essentially purified.

The specific components of echinacea responsible for this effect are the polysaccharides, alkylamides, and cichoric acid. While each component is effective alone, the greatest degree of immune stimulation is noted when the three active components are used in combination in the form of Echinamide.\textsuperscript{9} This was proven in research conducted by Dr. Tapan Basu of the University of Alberta, Canada, using Echinamide because of its consistent, standardized nature. What Dr. Basu demonstrated was the phenomena of synergy along with a clear dose-dependent effect. In other words, Dr. Basu demonstrated that the immune enhancing effects were greater with all three actives working together than any individual active and that the higher the dose of Echinamide, the greater the effect on macrophage function.

Dr. Basu and others have also demonstrated that, besides enhancing the ability of the macrophages to engulf and destroy foreign molecules, the active components of echinacea also help the macrophages detect
foreign matter in the blood and signal the other parts of the immune system to mount an attack.

This signal is in the form of chemical messengers. More than a dozen different factors have been identified that enable the body to communicate internally when an invasion occurs. Interestingly, some of these messengers have been developed as drugs through genetic engineering. Two such elements are interleukin-1 (IL-1) and granulocyte colony stimulating factor (GCSF). While these purified agents show promise as immune boosters, especially in cancer patients, they are extremely expensive at this time. Echinamidine could be an effective and reasonably priced, safe alternative to these expensive drugs.

Echinacea and the Lymphocytes (not a rock band)

Echinacea also affects the lymphocytes, white blood cells that act as the immune system’s “special forces”, combination Green Berets and Navy Seals. Lymphocytes use special destructive chemicals, search-and-destroy tactics and highly sophisticated communication techniques. About eighty percent of your lymphocytes are “T cells” that mature in the thymus gland—the major “base camp” for the immune team—which consists of two pinkish lobes in the upper chest. T cells are responsible for an important immune response known as cell-mediated immunity. Some T cells (“killer T cells”) destroy invaders by attaching to them and causing them to break apart.
Other T cells (“helper T cells”) release special chemical messengers, calling other types of immune cells to the scene of attack and encouraging them to do their job. Once the mission is accomplished, another type of cell, the “suppressor T cell”, arrives and issues orders to stop the attack.

Cell-mediated immunity is extremely important in providing resistance to infection by mold-like bacteria, yeast (including Candida albicans), fungi, parasites, and viruses (including herpes simplex, Epstein-Barr virus, and viruses that cause hepatitis). If a person is suffering from an infection by these organisms, it’s a good indication that their cell-mediated immunity is not functioning up to par. Cell-mediated immunity is also critical in protecting against the development of cancer, autoimmune disorders such as rheumatoid arthritis, and allergies. Not surprisingly, echinacea has been used to treat all of these conditions.

The other major type of lymphocyte is the B cell. These cells are responsible for the immune response called humoral immunity. Like alert sentries, B cells recognize the specific types of foreign particles present, including bacteria, yeast and viruses. These foreign particles are referred to as antigens. In response to an antigen, B cells produce an antibody. Antibodies (also
known as immunoglobulins) are special protein molecules that attach to antigens. If the antigen is on the surface of an invading organism (a pathogen, or disease causing organism), the antibody will bind to it and lead to its destruction. Each antibody must be tailor-made to fit the specific invader, so it takes a few days for B lymphocytes to crank out enough of them to be effective. In contrast, the cell-mediated response by T cells is immediate.

**Old Soldiers Keep Fighting**

Helper T cells and B lymphocytes have relatively long lives and excellent memories. The next time an invader tries to attack the cells, they remember how they mounted the previous defense. T cells send messages to B cells, ordering them to produce the same type of antibodies that worked before. Basically, this memory process translates into lifelong immunity and is the same mechanism by which vaccines work. Vaccines produce a simulated infection by introducing the antigen without a viable organism. The body mounts an attack just as if it was infected. However, unlike actual infections, many
vaccines do not produce lifelong immunity and “booster shots” may be required for the vaccine to continue to be effective. Also, some organisms, like flu viruses, outsmart the body’s defenses by mutating.

<table>
<thead>
<tr>
<th>CELL-MEDIATED (T CELL) IMMUNITY</th>
<th>HUMORAL (B CELL) IMMUNITY</th>
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<tr>
<td>Protects Against:</td>
<td>Protects Against:</td>
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<tr>
<td>Most viruses (e.g., herpes simplex)</td>
<td>Some viruses (e.g., measles)</td>
</tr>
<tr>
<td>Most mycoplasma (e.g., tuberculosis)</td>
<td>Most bacteria (e.g., strep and staph)</td>
</tr>
<tr>
<td>Most yeast (e.g., candidiasis)</td>
<td>Most parasites (e.g., giardia)</td>
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The remaining types of lymphocytes are the natural killer cells. Natural killer (NK) cells got their name because they can destroy cells that have become cancerous or infected with viruses. They are especially important because they provide vital protection against the development and spread of cancer.

**Echinamide on the Front Lines**

Echinacea affects lymphocytes in an indirect and direct manner. The indirect manner is via enhancing macrophage function. Macrophages assist lymphocytes in many ways. For example, it is the macrophage’s job to grab hold of the organism and present it to a lymphocyte for “processing”. In this respect the macrophage is a lot like the military police apprehending a suspect and the lymphocyte is like the judge at a court martial deciding how the suspect should be treated. By being better able to apprehend the culprit, there is a better chance that it will be brought to justice.
Echinacea directly affects lymphocytes by literally turning them on. This action is referred to as “nonspecific T-cell activation”. By doing this, echinacea leads to a cascade of effects including improved overall function of the lymphocytes and secretion of many immune enhancing chemicals known as lymphokines.

One of the ways echinacea is thought to enhance lymphocyte function is by increasing the lymphocyte’s ability to multiply when faced with a challenge. Lymphocytes are valuable resources. The body does not want to mobilize them unless they are really needed, but when they are needed it is important that they multiply rapidly to mount an effective defense. Echinacea is believed to push the lymphocytes into active duty as well as increase their ability to multiply. Next, echinacea may enhance their ability to form antibodies, increase production of the body’s own antiviral compound, interferon, and promote secretion of lymphokines.

With increased B cell function, more viruses and other infecting organisms are tagged with antibodies so that the macrophage can identify them for complete destruction. In our analogy of the macrophages as “MPs” and the lymphocytes as judge (and jury), once
the criminal has been charged, it is once again the job of the MPs to take him away. The difference here, however, is that the officer in this case is also responsible for the lethal injection and cremation!

Echinacea and the Killer Cells

The effect of echinacea on natural killer (NK) cells is particularly interesting. As mentioned, these cells are extremely important in fighting against cancer and viral infections. Typically NK cell activity is reduced in individuals suffering from either chronic viral illness (such as chronic hepatitis or chronic fatigue syndrome) or cancer. Also, a decline in NK cell number or activity is also a common feature of aging. A recent study was designed to assess the numbers and production of NK cells in aging, normal mice, after administration of echinacea for 14 days, compared with the injection of thyroxin (thyroid hormone), a known stimulant of NK cell function.

Results revealed that echinacea, but not thyroxin, had the capacity to increase NK cell numbers in aging mice. This suggests that echinacea increased new NK cell production in the bone marrow, leading to an increase in the absolute numbers of NK cells in the spleen, their primary destination. Echinacea’s ability to increase NK cell numbers was paralleled by an increase
in their anti-tumor capacity. These results indicate that echinacea may also help boost NK cells in aging humans. Other studies have also shown enhanced NK cell activity and function with echinacea use.¹⁴

**And for Our Next Trick...**

Does echinacea have other effects on immunity? Yes, several. One of the most interesting and perhaps one of the first discovered effects of echinacea is its effect on the "complement system". This system is one of the body’s first lines of defense and it acts like a sophisticated team of "reconnaissance" troops sent to patrol the battle zone looking for potential enemies.

The process of phagocytosis is an effective attack, but it takes time. So, the body also needs a faster acting attack force. It has one. This is the complement system—a system of about 20 different proteins secreted by the liver that can be activated to destroy infecting organisms and particulate matter. For example, one of the ways complement can destroy bacteria is by attaching itself to the invader in a way that sends a very powerful chemical signal out to monocytes (the blood macrophages) and neutrophils (those other white blood
cell that engulf and destroy bacteria). This has an effect on the monocytes and neutrophils similar to waving a red flag at a bull. Other ways complement can destroy organisms is by poking holes in the organism’s outer membrane, allowing water to rush in and important cellular components to rush out, causing the organisms to clump together (agglutinate).

Complement circulates in the blood looking for foreign material. In humans, cell surfaces contain special molecules that tell complement not to attack. Most organisms do not have these special molecules and the complement system considers them foreign invaders.

**Echinacea and the Complement System**

Echinacea affects the complement system both directly and indirectly. Echinacea enhances macrophage function and this automatically increases the production of complement because when macrophages are activated they send a signal to the liver to make more complement. Echinacea also directly increases the level of important complement system proteins in the blood. So it is a double-effect that enhances the likelihood of a successful quick response to an infecting organism. The effect on the
complement system is probably one of the key reasons why echinacea, and especially Echinamide, is most effective against the common cold if treatment is started at the first hint of a cold.

**Echinacea Versus Viruses**

Is echinacea antiviral? Yes. Various echinacea components have been shown to possess antiviral activity against the influenza, herpes and viruses that can cause the common cold. However, although echinacea components may exhibit direct antiviral effects, the primary antiviral effects of echinacea may be due to the herb’s ability to increase levels of the body’s own antiviral forces.

Echinacea seems to increase production of a compound known as interferon and it helps inhibit an enzyme called hyaluronidase. This enzyme is secreted by the virus and “inhibited” by cichoric acid. Hyaluronidase was originally known as the “spreading factor” because many organisms secrete it to breakdown connective tissue or intracellular “cement” that hold our cells together. Hyaluronic acid is an important structural component in our cells. The hyaluronidase enzyme dissolves the hyaluronic acid. Imagine your house having its doors and windows dissolved. That is similar to the result produced by the enzyme on connective tissue as it dramatically increases the permeability and allows the organism to anchor itself in the body.
Interestingly, echinacea was historically used for the treatment of snake bites. Although there have been no clinical studies to investigate this application, it has been reputed to be quite helpful. What is interesting about this folk use is the fact that most snake venoms permeate the system as a result of hyaluronidase in the venom breaking down the connective tissue substance. The bottom line here, in regards to echinacea’s antiviral effects, is that by inhibiting hyaluronidase and generally enhancing immunity, echinacea is probably more effective against viruses than if it relied on its own antiviral activity.

**Echinacea Against the Yeast Beast**

Echinacea polysaccharides have also been shown to inhibit Candida albicans infection in rats infected intravenously with a lethal dose of Candida albicans.\(^{18}\) The effect of echinacea against C. albicans noted in animal studies has been confirmed in several clinical studies. One study demonstrated that echinacea greatly enhances the effectiveness of a topical anti-yeast agent (ketoconazol nitrate) decreasing recurrence from 60.5% to 16.7%. The researchers used standardized
skin tests to show that this enhancement was due to echinacea’s boosting of cell-mediated immunity.19

Echinamide: Beyond Immunity

Besides being a fantastic ally of the immune system, echinacea has been particularly valued for its wound healing properties. This is due to its ability to promote tissue regeneration and reduce inflammation.20,21 In addition to its effects on hyaluronidase (this enzyme will also be released by the body’s own cells during an inflammatory process), echinacea also stimulates the growth of cells known as fibroblasts. These cells are responsible for the manufacture of the intracellular cement substance discussed earlier. In particular, echinacea has been shown to increase the manufacture of structural molecules critical in wound healing.22

Another interesting effect of echinacea involves enhancing the functioning of the adrenal glands, indicating that echinacea may be useful in helping us deal with stressful events more effectively.23 Clinical studies indicate that echinacea can help prevent stress-induced suppression of immune function. While it is generally thought that the primary effect is due to echinacea’s enhancement of immune function, this action on the adrenal glands may also play an important role.
More than 30 clinical studies have been done with echinacea preparations. Most of these studies involved the prevention and treatment of the common cold and used fresh-pressed juice from the above-ground (aerial) portion of the *E. purpurea* plant, along with 22 percent ethanol (for preservation). Unfortunately, this form of echinacea is probably not the most beneficial because it has lower concentrations of key immune enhancing. Furthermore, as previously stated, there was no standardization in the levels of active compounds for any of the echinacea products used in these studies. This fact makes analysis very difficult and very nearly invalidates the results.

Nonetheless, numerous clinical studies have confirmed echinacea’s immune enhancing actions. Various echinacea extracts or products have shown results in general infectious conditions, influenza, colds, upper respiratory tract infections, urogenital infections, and other infectious conditions.