

Healthy Immunity

a **DSM** Product



DSM Nutritional Products

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Is your immune system up to the challenge?

Protection from the unknown

The appearance of the SARS virus (severe acute respiratory syndrome) demonstrated how vulnerable we can be to the onslaught of virulent new diseases. With today's truly international community, pathogens have the opportunity to sweep across the globe in a matter of days with far reaching effects on public health and safety, disruption of the tourist industry and even economic downturn. A common feature of novel diseases is frequently the lack of effective treatments or vaccines, because these take considerable time to develop. In such cases, we have to rely on our natural immune defense to protect us as far as possible, and for this a healthy and effective immune system is an essential requirement. A healthy immune response depends on a complex interaction between the various cell types of the immune system, mediated by a host of intra and inter-cellular signaling molecules. The type of immune response mounted depends on the type of challenge perceived. Broadly speaking this may be microbial, viral, or allergenic, or, as in the case of many cancers, it may arise from within the body itself.

It is no surprise that there is some truth in the old adage «an apple a day keeps the doctor away», which originated in the 19th Century. Nutrition plays a pivotal role in maintaining immunity and the body's ability to fight infections. A range of micronutrients such as vitamins, carotenoids, fatty acids and minerals play specific and vital roles in optimising the functioning of the immune response against these challenges. Based on current scientific evidence the suggested intake ranges of nutrients that help promote a healthy immune system are outlined in Table 1, although the list is not necessarily exhaustive. The list of recommended nutrients is divided into recommendations for children (for example malnourished children in developing countries) and for adults.



Table 1:
Immunity concept – suggested nutrients and intake ranges

	Children (4-8 years of age) based on FNB RNI's*	Adults (including immunocompromised)
Vitamins		
Vitamin A	400 µg	800 µg
Vitamin D ₃	5 µg	10 µg
Vitamin E	7 TE	15 TE (up to 100 TE)
Vitamin C	25 mg	150 mg (up 1000 mg)
Vitamin B ₁	0.6 mg	2 mg
Vitamin B ₂	0.6 mg	1.2 mg
Vitamin B ₆	0.6 mg	2.0 mg
Niacin	8.0 mg	16 mg
Vitamin B ₁₂	1.2 µg	3 µg (up to 30 µg)
Folic Acid	200 µg	400 µg
Pantothenic acid	3 mg	5 mg
Biotin	12 µg	30 µg
Carotenoids		
Beta-carotene	1 mg	2 mg
Lycopene	1 mg	2 mg
Lutein/Zeaxanthin	1 mg	2 mg
Trace elements		
Iron	10 mg	0-3 mg
Zinc	5 mg	10 mg
Copper	0.5 mg	1 mg
Selenium	30 µg	60 µg
PUFA		
EPA+DHA	200 mg	650 mg
GLA	200 mg	500 mg (up to 1000 mg)
Teavigo™	25 mg	50 mg
a highly purified extract from green tea (> 93% EGCG).		
Nucleotides	25 mg	100 mg
Probiotics	–	10 ⁹ CFU

* Food and Nutrition Board recommended nutrient intakes

** CFU = colony forming units



Live healthier for longer

In Western Europe, the age pyramids are changing. Whilst the birth-rate is declining, people are living longer due to improved nutrition, diagnosis and healthcare. There is an increasing demand to lead an active life for longer. However, because of accumulating physiological stress associated with ageing, elderly people are prone to a reduced immune response.

A sub-optimal nutritional status is considered to be a key factor to reduced immune response in the elderly. Many epidemiological studies have demonstrated an association between nutritional status and immune function and a number of intervention studies have supported these findings, yet elderly people are at high risk of malnutrition and often fail to meet the RDA's of a number of vitamins.





Ageing of the immune system

Like many other body functions the immune system tends to weaken with age. Antibody response to vaccine for example, seems to be lower in the elderly especially if essential nutrients are lacking in their diet. Dietary supplementation with vitamins, carotenoids, minerals and trace elements can reverse this trend resulting in increased resistance and less infections.

Vitamin E is the major lipid-soluble antioxidant in the body and has been implicated in a host of immune responses in studies on both humans and animals, frequently in aged subjects.

Such findings underline the importance of the correct balance of nutrients for optimal immune function and also highlight that effects on the immune system are unlikely to be confined to individual nutrients, but rather reflect a complex interaction between a combination of several different factors.

Antioxidant vitamins can also be of benefit to patients of certain viral diseases. For example supplementation of HIV patients with antioxidant vitamins has been shown to result in a significant decrease in oxidative modification of lymphocyte DNA, a process which is thought to play a role in progression of the infection to AIDS. The data suggested that people infected with HIV could benefit from treatment with antioxidant vitamins. Clearly such results require further investigation, and vitamin supplementation should in no way be thought of as a replacement for conventional treatment of serious diseases, but rather as a complementary approach.



Vitamin C in hot demand

When discussing the effect of vitamins on the immune response, one cannot overlook vitamin C, a potent antioxidant and probably the best known of all vitamins. The majority of people associate vitamin C with a protection against infection, especially colds and flu. Indeed, experiments have shown that high doses of vitamin C supplementation may reduce the incidence, duration and severity of the common cold and use of vitamin C products typically rises dramatically during the winter. White blood cells, which eliminate invading microorganisms, need high concentrations of vitamin C to function properly.

In addition epidemiological studies have suggested that vitamin C in combination with carotenoids may be involved in the suppression of *Helicobacter pylori* infections, a risk factor for gastric cancer.





Vitamin A is essential in malnourished children

In addition to vitamin C and E, vitamin A is also considered to play a vital role in a healthy immune response. Vitamin A deficiency (prevalent amongst children in developing countries) results in greater susceptibility to diarrhoea, respiratory disease and higher mortality rates. Supplementation of malnourished children with vitamin A reduces measles and other infections with the consequence of reduced infant mortality.





Nature's colours liven up your immune system

Carotenoids have been implicated in several other aspects of immune response, including the modulation of T-lymphocyte function. Supplementation with carotenoid-rich foods has been shown to result in elevated secretion of interleukins (which stimulate the activity of other immune cells) by specialised immune cells. There is also evidence to suggest that beta-carotene favourably influences the proliferation and activity of immune cells.





B-vitamins

The B vitamins are typically associated with metabolism, energy transfer or reduction of homocysteine, a risk factor for heart disease. However, B-vitamins are also essential in maintaining an optimal immune response. For example, serum concentrations of vitamin B₆ and folic acid are positively correlated with lymphocyte counts and interleukin-2 levels. A recent clinical trial has shown that lymphocyte proliferation is increased in a group of women supplemented with vitamin B₆.

A holistic approach: not only vitamins

In addition to vitamins and carotenoids, several other micronutrients have a role to play in the immune response. For example, long chain polyunsaturated acids (PUFA's) are well known for their beneficial effects on cardiovascular health. There is now growing evidence that dietary n-3 and n-6 PUFA's, also increasingly available as dietary supplements, play a role in immune defense. PUFA's may modulate immune function in a number of ways including reduction of inflammation, notably in skin conditions. PUFA's have also been implicated in suppression or stimulation of various components of the immune system.



On the trail of novel nutraceuticals

Recent years have been marked by a shift in focus towards novel nutraceuticals, and some of these have a role in immune function. Many nutraceuticals have their origins in traditional remedies. Green tea has for centuries been attributed with a range of health benefits. One of the active components of green tea, epigallocatechin gallate (EGCG), has potent antimicrobial activity and may play a role in prevention of microbial infection of the mouth, hence reducing tooth decay. The results of in vitro tests have given promising results suggesting an immunomodulatory effect of EGCG on macrophages. Green tea and EGCG have also been implicated in the stimulation of B-lymphocytes, T-lymphocytes and Natural Killer Cells, and are thought to have an anti-inflammatory effect.

Nucleotides have also enjoyed a recent increase in popularity amongst users of dietary supplements. Several studies have indicated that nucleotides produce beneficial immunological effects, especially during times of rapid growth and in early life. In fact, nucleotides are also increasingly considered as important components of infant formula, and are used in more than 30 countries. Infants fed nucleotide-enriched formula were found to have improved antibody response to diphtheria and Hemophilus influenzae type B vaccines.



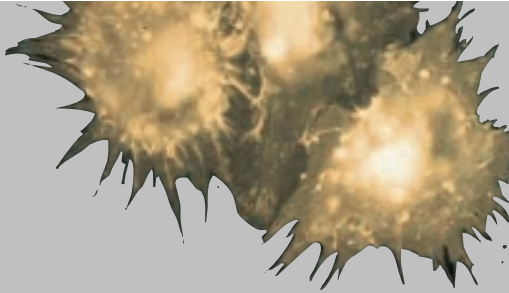
Probiotic bacteria and immunity

Probiotics are beneficial bacteria which if consumed on a regular basis are able to colonize the human intestine. These bacteria are part of a healthy colonic flora. Probiotic bacteria are strains belonging to the group of lactic bacteria such as *Lactobacillus** and *Bifidobacterium**. Some strains naturally grow in dairy foods such as yogurt and kefir. Breastfed infants naturally develop a flora predominantly based on *Bifidobacterium bifidus*.

Since ancient times the use of probiotic bacteria has been associated with good health and longevity. Indeed research conducted over the last 20 years has shown that probiotic bacteria can survive passage through the stomach and become an integral part of the intestinal flora adhering to mucosal cells of the lower intestine and colon.

*LAFTI®: a range of second-generation probiotics from DSM.





Balanced intestinal flora

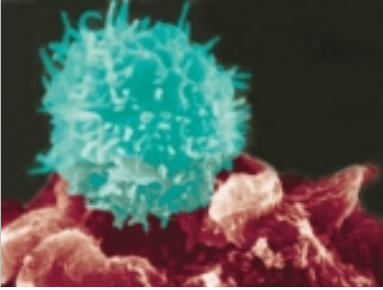
Probiotic bacteria live in close symbiosis with the host and other bacteria of the intestine. The flora stays in a delicate balance with the body's immune system. This balance can severely be disturbed by use of antibiotics and by infection with intestinal pathogens and anaerobic bacteria. This often results in diarrhoe and loss of regular bowel habits. Regular intake of probiotic bacteria has been found to reverse diarrhoe and to restore regular bowel function.

Immunoenhancing properties

Research has shown that probiotic bacteria – if ingested on a regular basis in sufficient high amounts – can displace more harmful pathogenic bacteria such as *bacteriodes* and *clostridium*. As probiotics stay on the surface of villi cells they enter in a close relationship with the host's immune system. In this role probiotics modulate the complex relationship between bacteria and the host resulting in less allergenicity and a stronger immunity of the organism as a whole.

Probiotics play a role in colon cancer prevention

Certain bacteria of the intestine can trigger a cascade of events leading to the formation of mutagens and other harmful fermentation products. If unchallenged over time this process leads to precancerous lesions and eventually to colon cancer.



Experimental research has shown that by their ability to displace harmful bacteria, probiotics may protect the host from colon cancer.

Looking to the future

Science is explaining in detail exactly why an apple a day can contribute to a healthy immune response, and the truth behind the anecdote remains as a sound reminder that an adequate and balanced diet promotes an healthy immune response. Moreover, nutrients exert their effects by influencing individual cells of the immune system. The complexity of the immune system requires that a full range of nutrients are essential for it to work effectively. A diet rich in fruits and vegetables supplemented with probiotic bacteria strenghtens immunity and reduces the risk of disease.



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Glossary

Allergen: A substance that provokes an allergic reaction.

Antibodies: Substances produced by B cells that react with antigens and prepare them for destruction.

Antigen: A substance that triggers an immune response.

Autoimmune disease: A disease in which the body's immune defences react to the body's own cells as though they were foreign, leading to destructive effects.

B cell (or B lymphocyte): A sub-set of lymphocytes originating from bone marrow, that can develop into antibody-producing cells.

CD4: a protein embedded in the surface of some T-cells and certain other cells (e.g., macrophages, dendritic cells). HIV invades cells by attaching to their CD4 receptor.

Cytokine: A biologically active peptide synthesized mainly by lymphocytes or monocytes and macrophages. Cytokines act as regulatory molecules that alter the function of target cells in immunological reactions.

Dendritic cell: a type of immune cell with many branches. Dendritic cells are found in the skin and mucosal membranes. They are typically the first to arrive at sites of injury or infection, where they bind to invaders and transport them to the lymph nodes where the cell-mediated immune response is initiated. Dendritic cells carry the CD4 surface marker, and may be among the first cells to be infected by HIV.

DHA: Docosa-hexaenoic acid: 22:6 omega-3. A long chain omega-3 fatty acid found in the brain, retina and heart.

EGCG

Epi-gallo-catechine-gallate, the major antioxidant in green tea and green tea extract, belonging to the group of polyphenols.

EPA: Eicosa-pentaenoic acid: 20:5 omega-3. A long chain omega-3 fatty acid. Metabolites derived from EPA are called eicosanoids.

GLA: Gamma-linolenic acid: 18:3 omega-6. A long chain omega-6 fatty acid with 3 double bonds; important for skin health.

HIV: Abbreviation for human immunodeficiency virus (the virus that causes AIDS).

Homocysteine: A sulfur-containing amino acid, which is an intermediate in the metabolism of another sulfur-containing amino acid, methionine. Elevated homocysteine levels in the blood have been associated with increased risk of cardiovascular disease and stroke.

Immunity: the immune system guards the body against invasion by foreign microorganisms and molecules.

Interleukin: a hormone (cytokine) that acts as a messenger in the immune system.

Interleukin-2: a cytokine produced by activated CD4 cells that promotes the proliferation and activity of CD4 cells, and natural killer cells. IL-2 is associated with cell-mediated immune response.

Lymphocyte: white blood cell.

Macrophage: Type of phagocytic cell present in tissues.

Natural killer cells: Type of lymphocyte that attacks and destroys infected or cancer-causing cells without antigen stimulation.

Phagocytic cell: A cell that engulfs and destroys other cells and bacteria.

Probiotics: Live bacteria that are beneficial to health.

Prostaglandins: Tissue hormones derived from PUFA which possess diverse biological actions in the immune system.

T cells (or T lymphocytes): A sub-set of lymphocytes defined by their development in the thymus. T cells induce, regulate and effect specific immune responses after stimulation by antigen.

Interested in this Vitality Concept?

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