

VK VITAMIN C - PROFILE

The human immune system is a highly advanced machine, finely tuned over thousands of years to battle against continuous challenges to human health.

When you support your immune system with the right lifestyle, diet, and nutrients, then it becomes like a prizefighter.

VK VITAMIN C, (“VK” for short), is a product of the times. It was created in response to the difficult world situation that first made itself apparent in late 2019. The world has spent the last three years or so learning the value of constant immune system vigilance and protection.

VK offers more unique ingredients specifically designed to help support immune function and keep you well. Its current Health Canada Filing under NPN 80107556, allows the following claims to be made:

THE BENEFITS OF VK VITAMIN C

- + Supports healthy immune function.
- + Supports replication of T-Cells and B-Cells.*
- + Induces synthesis of heat shock proteins 70 & 90.*
- + Assists in the formation of Vitamin C in the body.*
- + Health prebiotic to improve microbiome.*
- + Prevents fibrosis (scarring of tissue).*



However, this unique formulation will soon go through a clinical study, to hopefully be able to state added health claims to include the main purpose for its development.

Tissue culture tests of VK’s antiviral activity have been successfully done at a Canadian University. The next step that is required to permit making the antiviral claim is the successful result of a human clinical trial. Screening of human subjects for the upcoming clinical trial is now underway.

**Elaborations of the approved statement. All the materials excerpted from published papers are included to indicate what has been studied and established by independent researchers.*

VK VITAMIN C - INGREDIENTS



MODIFIED CITRUS PECTIN

Pleiotropic Effects of Modified Citrus Pectin ABSTRACT: Modified citrus pectin (MCP) has a low molecular weight and low degree of esterification to allow absorption from the small intestinal epithelium into the circulation. MCP produces pleiotropic effects, including but not limited to its antagonism of **galectin-3****, which have shown benefit in preclinical and clinical models.

Regarding cancer, MCP modulates several rate-limiting steps of the metastatic cascade. MCP can also affect cancer cell resistance to chemotherapy. Regarding fibrotic diseases, MCP modulates many of the steps involved in the pathogenesis of aortic stenosis. MCP also reduces fibrosis to the kidney, liver, and adipose tissue. Other benefits of MCP include detoxification and improved immune function. This review summarizes the pleiotropic effects of MCP .

([Eliaz & Raz, 2019, Abstract section](#)).

****Galectin-3** is a protein that plays multifaceted roles within the body, demonstrating both positive and negative functions across various physiological processes.

Positive Functions:

- **Immune Response Regulation:** Galectin-3 contributes to immune system modulation by influencing the activation, migration, and function of immune cells such as macrophages, dendritic cells, and neutrophils. It aids in pathogen recognition and clearance, promoting an effective immune response against infections ([Xiao et al., 2022](#)).
- **Tissue Repair and Fibrosis:** In certain contexts, Galectin-3 facilitates tissue repair mechanisms and wound healing. It modulates fibroblast activity and extracellular matrix deposition, contributing to tissue remodeling and regeneration following injury ([McLeod et al., 2018](#)). In short, Galectin-3 has historically played very short-term functions of pathogen and infection blocking, as well as short-term roles in tissue repair and wound healing.

However, in our modern world, there are huge overlapping lifestyle stressors, environmental chemical toxins, unhealthy processed food additives, toxic medications, etc., that have caused **CHRONIC STRESS CONDITIONS**. These have led to large segments of the population suffering from constant chronic stress, leading to the paradox of being in a state of having unhealthy chronic over-expression of galectin-3, with chronic inflammation and other pathologies. The body does not do well under chronic stress conditions.

Negative Functions:

- **Inflammatory Response:** While Galectin-3 aids in immune regulation, its excessive expression can promote chronic inflammation. Prolonged or dysregulated inflammatory responses mediated by Galectin-3 have been linked to various inflammatory diseases such as arthritis, cardiovascular disorders, and inflammatory bowel diseases, even cancers ([Stojanovic et al., 2023](#)).
- **Cardiac Fibrosis and Remodeling:** Galectin-3 overexpression has been implicated in adverse cardiac remodeling, contributing to fibrosis, hypertrophy, and impaired ventricular function in conditions like heart failure. It promotes collagen deposition, exacerbating fibrotic changes in the myocardium ([Suthahar et al., 2018](#)).
- **Neurodegenerative Disorders:** In the context of neurodegenerative diseases, Galectin-3 might exacerbate neuronal damage and inflammation. Its involvement in microglial activation and neuroinflammation has been observed in conditions such as Alzheimer's disease, contributing to disease progression ([Srejovic et al., 2020](#)).

Modified Citrus Pectin (MCP) has proven to be an excellent down regulator of over-expressed galectin-3.

A wide range of researchers are involved in the study of pectin polysaccharides (PPS), including chemists, biochemists, biotechnologists, plant physiologists, physicists, physicians, and cryobiologists. This is due to the fact that PPS, due to its unique properties, has an enormous potential for use in many fields of science and medicine.

ARE ALL MODIFIED CITRUS PECTINS THE SAME, OR DOES SIZE MATTER?

Answer: Modified citrus pectin (MCP) can be created from source pectin in several ways. The resulting pectin fragments will have characteristic molecular weights and degrees of esterification ("Branch-chainedness") depending on how the original pectin was treated. It is possible to create whatever fragments are wanted by altering the creation pathway.

For the VK Vitamin C formula, NuYugen's current favored method creates consistent fragments of molecular weights in the range of 5000 - 7000 Daltons, (or 5 - 7 kD), with a % degree of esterification of less than 5%. Research shows that this fragment is optimal for binding circulating and cell-surface galectin-3.

It is hypothesized that fragments of distinct characteristics will treat different disease situations differently. However, it is generally believed that the lower the molecular weight, the more easily it can be transported into the cells, making it more bio-actively effective.

Health Canada has granted NuYugen's formulator a NPN that allows for MCP of any characteristic (Molecular weight up to 20,000 Daltons, (20 kD), with any % degree of esterification). More on size: [Letter to the Editor: Not all modified citrus pectins are the same: size does matter.](#)

Modified citrus pectin (MCP) has been studied for various potential health benefits. Here are some of the researched health benefits of MCP:

- **Chelation Properties:** MCP has been researched for its ability to chelate heavy metals in the body, potentially aiding in their excretion:
 - **The role of modified citrus pectin as an effective chelator of lead in children hospitalized with toxic lead levels.**
 - **Conclusion:** The need for a gentle, safe heavy metal-chelating agent, especially for children with high environmental chronic exposure, is great. The dramatic results and no observed adverse effects in this pilot study along with previous reports of the safe and effective use of MCP in adults indicate that MCP could be such an agent. Further studies to confirm its benefits are justified ([Zhao et al., 2008, Conclusion section](#)).
 - **The effect of modified citrus pectin on urinary excretion of toxic elements:** This pilot trial provides the first evidence that oral administration of MCP increases significantly the urinary excretion of toxic metals in subjects with a 'normal' body load of metals ([Eliaz et al., 2006](#)).
 - **Integrative medicine and the role of modified citrus pectin/alginate in heavy metal chelation and detoxification - five case reports:** Heavy metal body burden can contribute to chronic disease, as well as interfere with the body's capacity to recover from illness. The five case studies presented here show that reduction in toxic heavy metals (74% average decrease) was achieved without side effects, with the use of modified citrus pectin (MCP) alone or with an MCP/alginate combination. The gradual decrease of total body heavy metal burden is believed to have played an important role in each patient's recovery and health maintenance ([Eliaz et al., 2007](#)).
- **Anti-Inflammatory Properties of MCP:** Your body uses short term inflammatory occurrences, in positive ways, at different sites to combat local infections and at areas of tissue injuries of some sort. Conversely, however, chronic inflammation is very damaging; even to the point of being involved in at least 8 of the top 10 killer diseases [Slavish].
 - **Slavish Identifies Inflammation as Leading Cause of Death in the U.S.:** It has long been known that stress increases a person's risk for several psychiatric conditions, such as anxiety, depression, schizophrenia, and post-traumatic stress disorder, as well as numerous physical disease conditions including asthma, rheumatoid arthritis, cardiovascular disease, obesity, diabetes, osteoporosis, Alzheimer's disease, certain

cancers, and stroke. “All told, inflammation is involved in at least 8 of the top 10 leading causes of death in the United States today,” writes Dr. Slavich.

“Understanding how inflammation promotes poor health, and how and when we can intervene to reduce inflammation-related disease risk, should thus be a top scientific and public priority” ([Lab & Lab, 2015](#)).

- **Galectin-3 is a sensor-regulator of toll-like receptor pathways in synovial fibroblasts:** Galectin-3 plays a significant role in the modulation of immune responses. It has been shown to aggravate joint inflammation and destruction in experimental arthritis. Galectin-3 was inhibited with modified citrus pectin (MCP), a polysaccharide galectin-3 ligand. MCP reduced IL-6 levels in a dose-dependent manner. Our results indicate that galectin-3 is a positive sensor-regulator of TLR-induced IL-6 secretion in human synovial fibroblasts, thus adding new insights into the mechanisms by which galectin-3 augments synovial inflammation ([Arad et al., 2015](#)).
- **Prevalence of mild cognitive impairment in type 2 diabetes mellitus is associated with serum galectin-3 level:** Galectin-3 (Gal3) contributes to insulin resistance, inflammation, and obesity, the three risk factors for mild cognitive impairment (MCI) in type 2 diabetes mellitus patients. Gal3 inhibitor-modified citrus pectin decreased serum and brain Gal3 levels in diabetic rats, accompanied by the amelioration of learning and memory impairment ([Ma et al., 2020](#)).
- **Neuroinflammation and oxidative stress act in concert to promote neurodegeneration in the diabetic retina and optic nerve:** Galectin-3 participation: Diabetes causes retinal pathological neurodegeneration, followed by vascular proliferative pathology. Both phases of the disease seem to be mediated by inflammation and consequent oxidative stress. Since galectin-3 inhibition is currently being tested in clinical trials to treat non-alcoholic steatohepatitis, solid tumours, plaque psoriasis and atopic dermatitis, its application in clinical trials against the neurodegenerative aspects of diabetes are encouraged by the preclinical studies presented in this review ([Rocha et al., 2019](#)).
- Research suggests that MCP might have immunomodulatory effects. A study published in the Journal of Natural Products (2013) investigated MCP's effects on immune response regulation [[Absence of galectin-3 promotes neuroprotection in retinal ganglion cells after optic nerve injury](#)].

● Immune System Support:

- **Research suggests that MCP might have immunomodulatory effects:** A study published in the Journal of Natural Products (2013) investigated MCP's effects on immune response regulation [[Absence of galectin-3 promotes neuroprotection in retinal ganglion cells after optic nerve injury](#)].
- **Activation of Human T-Helper/Inducer Cell, T-cytotoxic cell, B-cell and Natural Killer (NK)-Cells and induction of Natural Killer Cell Activity against K562 Chronic Myeloid Leukemia Cells with Modified Citrus Pectin:** Modified citrus pectin (MCP) is known for its anti-cancer effects and its ability to be absorbed and circulated in the

human body. In this report we tested the ability of MCP to induce the activation of human blood lymphocyte subsets like T, B and NK-cells.

- **CONCLUSIONS:** MCP has immunostimulatory properties in human blood samples, including the activation of functional NK cells against K562 leukemia cells in culture. Unsaturated oligogalacturonic acids appear to be the immunostimulatory carbohydrates in MCP ([Ramachandran et al., 2011](#)).

- **Anti-Cancer Properties:** There's growing interest in MCP for its potential anti-cancer effects, particularly in preventing the spread (metastasis) of cancer cells.
 - **Pectin - An emerging new bioactive food polysaccharide:** In addition to the health benefits associated with dietary fiber, new health claims are emerging, particularly about the bioactive roles of modified pectin as an anti-cancer agent. These suggest that the modification creates molecular fragments, some of which may bind to and inhibit the various actions of the pro-metastatic protein galectin-3 ([Maxwell et al., 2012](#)).
 - **Modified citrus pectin anti-metastatic properties:** One bullet, multiple targets. This paper describes the ability of modified citrus pectin (MCP) to affect numerous rate-limiting steps in cancer metastasis. The anti-adhesive properties of MCP as well as its potential for increasing apoptotic responses of tumor cells to chemotherapy by inhibiting galectin-3 anti-apoptotic function are discussed in the light of a potential use of this carbohydrate-based substance in the treatment of multiple human malignancies ([Glinsky & Raz, 2009](#)).
 - **Plant Pectin: A Potential Source for Cancer Suppression:** The interactions and inactivation of oncogenes by CP and MCP in prostate, breast, liver, lung, melanoma and multiple myeloma cancers suggests that CP and MCP could play an important role in cancer chemotherapy and chemoprevention ([Niture, 2013](#)).
 - **A New Approach to Metastatic Cancer Prevention: Modified Citrus Pectin (MCP), A Unique Pectin that Blocks Cell Surface Lectins:** MCP may specifically combine with, and block, lectin molecules on the cell surface that mediates metastasis. These findings and their implications for human cancer management are the subject of this review ([Kidd, 2002](#)).
 - **Pectin: A Bioactive Food Polysaccharide with Cancer Preventive Potential:** Colon and breast cancer are among the diseases for which data suggest that modified pectin (MP), specifically modified citrus pectin (MCP), has beneficial effects on the development and spread of malignancies, in addition to its benefits as a soluble dietary fiber. Cellular and animal studies and human clinical trials have provided corroborating data. This review concludes that pectin has anti-cancer characteristics that have been found to inhibit tumor development and proliferation in a wide variety of cancer cells ([Emran et al., 2022](#)).

- **Cardiovascular Health:** MCP has shown promise in supporting cardiovascular health. Research published in the American Journal of Physiology-Heart and Circulatory Physiology (2008) suggested that MCP might help in preventing arterial stiffening, a risk factor for cardiovascular disease.
 - **Galectin-3 in cardiovascular diseases:** The role of Gal-3 as a prognostic marker of heart failure is described together with possible diagnostic applications to other CVDs. Finally, we report the tentative use of Gal-3 inhibition as a therapeutic approach to prevent cardiac inflammation and fibrosis ([Blanda et al., 2020](#)).
 - **Modified citrus pectin ameliorates myocardial fibrosis and inflammation via suppressing galectin-3 and TLR4/MyD88/NF-κB signaling pathway:** Study results suggest that MCP ameliorates cardiac dysfunction through inhibiting inflammation and MF. These effects may be through downregulating Gal-3 expression and suppressing activation of the TLR4/MyD88/NF-κB signaling pathway ([Xu et al., 2020](#)).
 - **Inhibition of galectin-3 ameliorates the consequences of cardiac lipotoxicity in a rat model of diet-induced obesity:** Gal-3 can modulate some of the metabolic consequences of obesity. Since the inhibitor of Gal-3 activity MCP reduced cardiac lipotoxicity and ameliorated the mitochondrial damage observed in the heart of obese rats ([Marín-Royo et al., 2018](#)).
 - **Role for Galectin-3 in Calcific Aortic Valve Stenosis:** Gal-3, which is overexpressed in AVs from AS patients, appears to play a central role in calcification in AS. Gal-3 could be a new therapeutic approach (using modified citrus pectin and Gal-3 blockade and knockdown system), to delay the progression of AV calcification in AS ([Sádaba et al., 2016](#)).

- **Gastrointestinal Health:** Some studies have investigated MCP for its potential benefits in gastrointestinal health, particularly in relation to inflammatory bowel disease (IBD). A study published in Carbohydrate Polymers (2015) explored the effects of MCP in a rat model of colitis.
 - **Dose-Dependent Effects of a Soluble Dietary Fiber (Pectin) on Food Intake, Adiposity, Gut Hypertrophy and Gut Satiety Hormone Secretion in Rats:** Increasing amounts of the soluble fermentable fiber pectin in the diet proportionately decreased food intake, body weight gain and body fat content, associated with proportionately increased satiety hormones GLP-1 and PYY and intestinal hypertrophy, supporting a role for soluble dietary fiber-induced satiety in healthy body weight regulation ([Adam et al., 2015](#)).
 - **Health-promoting properties of pectin:** Pectin has also received great interest as a source of dietary fiber. Furthermore, pectin is proven to have diverse biological activities including lipid and cholesterol level-lowering effects, serum glucose and insulin content-lowering effects, gastric emptying delay, and anti-cancer activities. Pectin and pectic oligosaccharides have been shown to induce apoptosis in human

colonic adenocarcinoma cells and to have anti-metastatic properties. Dietary pectin can bind metal ions, particularly lead ions, thus reducing their retention in the body and diminishing their toxic effects. On the other hand, pectin enhances intestinal solubility and absorption of ferric iron. Pectin with a low degree of esterification or having a large volume of linear oligogalacturonide segments shows significant mucoadhesion capacity in the gastrointestinal tract. In this way, pectin forms a physical barrier protecting epithelium against opportunistic microbial invasion during stress ([Wikiera et al., 2014](#)).

- **Pectins as a universal medicine:** (Pectin polysaccharides, pectins, PPS) PPS- based drugs are used to treat diseases of the digestive system (including dysbiosis) and the gastrointestinal tract (GIT). So, PPS activates motility and intestinal peristalsis, while slowing down the absorption rate of food and providing chemical and physical cleaning of the villi of the small intestine, improving the absorption of biologically active substances.
- In addition, PPS is used to prevent and treat vascular atherosclerosis, hypoglycemic conditions and diseases related to metabolic disorders (obesity, diabetes mellitus) and diseases of the liver and pancreas ([Зайцева et al., 2020](#)).

● Fibrosis Reduction, Using MCP to Inhibit Galectin-3

- **Modified citrus pectin stops progression of liver fibrosis by inhibiting galectin-3 and inducing apoptosis of stellate cells:** It can be concluded that MCP can attenuate liver fibrosis through an antioxidant effect, inhibition of Gal-3 mediated hepatic stellate cells activation, and induction of apoptosis ([Abu- Elsaad & Elkashef, 2016](#)).
- **Pectins from various sources inhibit galectin-3-related cardiac fibrosis:** Bioactive pectins are natural sources of galectin-3 inhibitors and may be helpful in the prevention of heart failure or other diseases characterized by fibrosis ([Gehlken et al., 2022](#)).
- **Galectin-3 mediates aldosterone-induced vascular fibrosis:** Our data indicate that Gal-3 is required for inflammatory and fibrotic responses to Aldo in vascular smooth muscle cells in vitro and in vivo, suggesting a key role for Gal-3 in vascular fibrosis ([Calvier et al., 2013](#)).

Sidebar Suggestion: Since MCP has demonstrated the ability to down-regulate over-expressed galectin-3's over-causation of fibrosis formation and inflammation, then it should be worthwhile to explore MCP's potential to mitigate reported post-COVID-19 mRNA Vaccine Myocarditis, as well as potential post-COVID-19 mRNA Vaccine's adverse involvement in vascular inflammation, as well as fibrous vascular occlusions and 'Long-Covid' symptoms.

Reference: ([Circulating Spike Protein Detected in Post-COVID-19 mRNA Vaccine Myocarditis](#))

VITAMIN C

An enormous number of products containing vitamin C are sold with the label claim “supports immune function.” That is why it is used here. Vitamin C supports the replication and function of both B and T cells.

Vitamin C is an essential nutrient for the human body. It is responsible for several crucial functions, such as:

- Boosting antioxidant levels. Lowering blood pressure.
- Protecting against gout attacks. Improving iron absorption.
- Vitamin C, or ascorbic acid, is a vitamin that has antioxidant properties, which helps reduce free radicals in the body, which have carcinogenic effects.
- Boosting immunity.
- Reducing heart disease and dementia risk.

HERE ARE THE FAR-RANGING BENEFITS OF NUTRITIONAL VITAMIN C AS WELL AS THE THERAPEUTIC BENEFITS OF HIGH-DOSE VITAMIN C.

Nutritional Benefits of Vitamin C:

- **Antioxidant Properties:** Vitamin C is a powerful antioxidant that helps neutralize free radicals, which can prevent oxidative stress and damage to cells.
 - **Two Faces of Vitamin C—Antioxidative and Pro-Oxidative Agent** ([Kaźmierczak-Barańska et al., 2020](#)).
- **Boosts Immunity:** It plays a crucial role in supporting the immune system by stimulating the production of white blood cells and antibodies. It aids in the body's defense against infections and illnesses.
 - **Vitamin C and Immune Function:** Vitamin C contributes to immune defense by supporting various cellular functions of both the innate and adaptive immune systems. Supplementation with vitamin C appears to be able to both prevent and treat respiratory and systemic infections ([Carr & Maggini, 2017](#)).
 - **Repositioning Vitamin C as a Promising Option to Alleviate Complications associated with COVID-19:** Compelling evidence also suggests that a high dose of vitamin C (1.5 g/kg body weight) in inflammatory conditions can result in effective clinical outcomes and thus can be employed to combat COVID-19. The current review aims to reposition vitamin C as an alternative approach for alleviating COVID-19-associated complications ([Farjana et al., 2020](#)).

- **Vitamin C in the Treatment of COVID-19:** Considering the pathophysiology and theoretical background, together with the preliminary reports and studies aforementioned, the role of vitamin C in the treatment of patients with SARS- CoV-2 infection should be further investigated ([Milani et al., 2021](#)).
- **The Long History of Vitamin C: From Prevention of the Common Cold to Potential Aid in the Treatment of COVID-19:** Interesting data on the possible use of vitamin C to prevent infections regarding special conditions (e.g., soldiers and athletes) and subjects with metabolic disorders, CVDs or frailty, in which the potential control of inflammation by a vitamin C supplementation could represent an effective aid in reducing the risk of infection, even for COVID-19 ([Cerullo et al., 2020](#)).
- **Collagen Synthesis:** Vitamin C is essential for collagen production, which is crucial for skin health, wound healing, and maintaining the health of bones, teeth, and cartilage.
 - **Ascorbic Acid (Vitamin C) as a Cosmeceutical to Increase Dermal Collagen for Skin Antiaging Purposes: Emerging Combination Therapies:** Ascorbic acid (AA) is an essential nutrient and has immense potential as a cosmeceutical that protects the health and beauty of the skin. AA is expected to attenuate photoaging and the natural aging of the skin by reducing oxidative stress caused by external and internal factors and by promoting collagen gene expression and maturation. In this review, the biochemical basis of AA associated with collagen metabolism and clinical evidence of AA in increasing dermal collagen and inhibiting skin aging were discussed ([Boo, 2022](#)).
- **Heart Health:** Regular intake of vitamin C has been associated with a reduced risk of heart disease by improving blood vessel function and lowering blood pressure.
 - **Vitamin C: new role of the old vitamin in the cardiovascular system?** As an electron donor, vitamin C acts as a cofactor for eight enzymes involved in collagen hydroxylation, biosynthesis of carnitine and norepinephrine, tyrosine metabolism and amidation of peptide hormones (see for a review Padayatty & Levine, 2001). Vitamin C has many nonenzymatic actions as well. It is a powerful water-soluble antioxidant, it protects low-density lipoproteins from oxidation, reduces harmful oxidants in the stomach and promotes iron absorption (see for reviews ([Carr & Frei, 1999a](#); [May 1999](#); [Padayatty et al ., 2003](#))).
- **Enhanced Iron Absorption:** Vitamin C enhances the absorption of non-heme iron (found in plant-based foods), thereby preventing iron-deficiency anemia.
 - **Dietary Sources, Bioavailability, and Functions of Ascorbic Acid (Vitamin C) and Its Role in the Common Cold, Tissue Healing, and Iron Metabolism:** Ascorbic acid is also popularly known as vitamin C or ascorbate. It is a water- soluble vitamin. Ascorbic

acid is necessary for bone formation, wound healing, connective tissue growth, and the maintenance of healthy gum tissue. Antioxidants like ascorbic acid shield the body from free radical damage. In many illnesses and conditions, vitamin C is employed as a medicinal agent. It improves the immunity of the body, reduces the severity of allergies, and aids in the management of infectious disorders. Additionally, ascorbic acid has health benefits for conditions including atherosclerosis, cancer, the common cold, iron deficiency anemia, etc. Ascorbic acid deficiency has been linked to anemia, infections, and bleeding gums. It is also associated with scurvy and poor wound healing. Ascorbic acid deficiency can result in capillary hemorrhage, muscle degeneration, atherosclerosis, neurotic disorders, etc. Ascorbic acid is often added in large doses to correct its deficiency. Toxicity is rare in comparison to fat-soluble vitamins. Ascorbic acid has also recently been studied in relation to infection and immunity. Given the wide range of biological, physiological, and therapeutic functions, this review will try to summarize some of the evidence ([Bhoot et al., 2023](#)).

- **Eye Health:** It may reduce the risk of cataracts and slow the progression of age-related macular degeneration due to its antioxidant properties.
 - **Ascorbic Acid Promotes the Stemness of Corneal Epithelial Stem/Progenitor Cells and Accelerates Epithelial Wound Healing in the Cornea:** This study shows direct evidence of the therapeutic benefits of ascorbic acid on the repair of corneal epithelial wounds and provides new insights into the mechanisms involved ([Chen et al., 2017](#)).
 - **Vitamin C protects retinal ganglion cells via SPP1 in glaucoma and after optic nerve damage:** Vitamin C possesses neuroprotective activities that are thought to be related to its properties as a co-factor of enzymes and its antioxidant effects. Here, we show that vitamin C promotes a neuroprotective phenotype and increases gene expression related to neurotropic factors, phagocytosis, and mitochondrial ATP production. This study identifies an additional neuroprotective pathway for vitamin C and suggests a potential therapeutic role of vitamin C in neurodegenerative diseases such as glaucoma ([Li & Jakobs, 2023](#)).
- **Stress Reduction:** Vitamin C has been linked to reducing the physical and psychological effects of stress by controlling the release of stress hormones.
 - **Vitamin C: Stress Buster:** The researchers believe that vitamin C should be considered an essential part of stress management. Studies showed that vitamin C abolished the secretion of cortisol in animals that had been subjected to repeated stress (Staff, 2003).

Therapeutic Benefits of High-Dose Vitamin C:

- **Cancer Support:** High-dose intravenous vitamin C is sometimes used as an adjunct therapy in cancer treatment. It is believed to help reduce the side effects of chemotherapy and improve the overall quality of life.
 - **Pharmacologic ascorbic acid concentrations selectively kill cancer cells:** Action as a pro-drug to deliver hydrogen peroxide to tissues: Ascorbate at concentrations achieved only by i.v. administration may be a pro-drug for the formation of H₂O₂, and that blood can be a delivery system of the pro-drug to tissues. These findings give plausibility to i.v. ascorbic acid in cancer treatment, and have unexpected implications for the treatment of infections where H₂O₂ may be beneficial ([Chen et al., 2005](#)).
 - **Understanding the Therapeutic Potential of Ascorbic Acid in the Battle to Overcome Cancer:** Several case studies and clinical trials on cancer patients have described that ascorbic acid at high doses, alone, or in combination with chemotherapies improves the quality of life with less toxicity. Vitamin C hinders cancer progression by targeting different vulnerable nodes such as HIF, GLUT1 and TET ([Reang et al., 2021](#)).
 - **Diverse antitumor effects of ascorbic acid on cancer cells and the tumor microenvironment:** Ascorbic acid exhibits antitumor effects in various carcinomas; however, clinical studies have not yet produced any significant evidence of these effects. Ascorbic acid exhibits antitumor effects through ROS-mediated mechanisms and as a cofactor. The mechanisms of ascorbic acid as a cofactor include effects on HIF α via PHDs and FIH-1 and epigenetic effects via DNA demethylase. Ascorbic acid can also modulate metabolism and epigenetic gene expression in immune cells as well as cancer cells. Ascorbic acid is also known to inhibit EMT of tumor cells. Here, we discuss the known antitumor effects of ascorbic acid ([Maekawa et al., 2022](#)).
- **Antiviral Properties:** In high doses, vitamin C has shown some potential in reducing the severity and duration of viral infections like the common cold and influenza.
 - **Antiviral Mechanisms of Vitamin C: A Short Communication Consensus Report:** Vitamin C has demonstrated potent antiviral activity when utilized in large doses either in strategically taken oral doses or by intravenous route (Colunga Biancatelli et al. 2020). Clinical evidence exists that shows vitamin C's potent antiviral effect. Studies in which very large amounts of vitamin C have been used to treat different viral infections have been published ([Gonzalez et al. 2014](#); [Marcial-Vega et al. 2017](#)).
 - **Vitamin C—An Adjunctive Therapy for Respiratory Infection, Sepsis and COVID-19:** Given the favorable safety profile and low cost of vitamin C, and the frequency of vitamin C deficiency in respiratory infections, it may be worthwhile testing patients' vitamin C status and treating them accordingly with intravenous administration within

ICUs and oral administration in hospitalized persons with COVID-19 ([Holford et al., 2020](#)).

- **Wound Healing:** High-dose vitamin C can promote faster wound healing due to its role in collagen synthesis and antioxidant effects.
 - **High-dose vitamin C supplementation accelerates the Achilles tendon healing in healthy rats:** High-dose vitamin C supplementation once every 2 days has stimulating effects on the Achilles tendon healing because of early angiogenesis and increased collagen synthesis in a healthy rat model ([Ömeroğlu et al., 2008](#)).
- **Sepsis Treatment:** Some studies suggest that high-dose intravenous vitamin C may have benefits in treating sepsis by reducing inflammation and oxidative stress.
 - **The Emerging Role of Vitamin C as a Treatment for Sepsis:** Given the multitude of mechanisms of action, vitamin C may succeed where other possible sepsis treatments have previously failed, or facilitate the success of a multi-modal approach ([Kashiouris et al., 2020](#)).
- **Neuroprotective Effects:** It is being investigated for its potential to reduce cognitive decline and neurodegenerative diseases due to its antioxidant properties.
 - **Neuroprotective Properties of Vitamin C: A Scoping Review of Pre-Clinical and Clinical Studies:** Although pre-clinical trials suggest that exogenous vitamin C improves biomarkers of neuroprotection, functional outcome, and mortality, these results have not translated to humans ([Kangisser et al., 2021](#)).
 - **Old Things New View: Ascorbic Acid Protects the Brain in Neurodegenerative Disorders:** Ascorbic acid is considered an important neuroprotective agent since it is a potent reducing agent, scavenging ROS production and sustaining superoxide dismutase and catalase activities. It also protects neurons against glutamate excitotoxicity, which is associated with neurodegenerative processes. However, ascorbic acid functions in the brain are broader than those based on its antioxidant properties ([Covarrubias-Pinto et al., 2015](#)).
 - **The Epigenetic Role of Vitamin C in Neurodevelopment:** Vitamin C has many established functions in the nervous system. It acts as a co-factor for a plethora of different enzymes which are involved in diverse processes including epigenetic regulation, the biosynthesis of catecholamine neurotransmitters and hormones, collagen production and angiogenesis. Another function of the micronutrient is scavenging reactive oxygen species (ROS). The TET enzymes regulate NPC biology, neurogenesis and higher brain functions and behaviors, and have recently been implicated in the etiology of neurological disorders. The dependency of the TETs on

vitamin C for optimal catalytic activity becomes particularly relevant when considering the impact of nutrition on epigenetics in development ([Coker et al., 2022](#)).

- **Inflammatory Response:** It is being investigated for its potential in reducing inflammation.
 - **Inflammatory Response Modulation by Vitamin C in an MPTP Mouse Model of Parkinson's Disease:** Vitamin C represents one of the safest and most essential nutrients, with antioxidant and anti-inflammatory properties that protect living organisms against oxidative stress; due to this propriety, it is studied for applications in the prevention and management of different pathologies, including neurodegenerative disease. Persistent neuroinflammation is detrimental to the brain and may lead to the pathogenesis and progression of neurodegenerative diseases like Parkinson's disease (PD) and Alzheimer's disease. Vitamin C reduces neuroinflammation by the modulation of microglial responses and astrocyte activation, reducing dopaminergic neuronal cell loss involved in PD insurgence ([Nuccio et al., 2021](#)).



D-GLUCURONOLACTONE

Glucuronolactone is a naturally occurring substance that is found in connective tissues and many plant gums.

- This ingredient is often put into energy drinks as a supplement to **enhance athletic performance**.
- It participates in **detoxifying activities in the liver**.
- It **reduces mental fatigue**.
- Liver microsomes synthesize D-Glucuronolactone and L-Gulonolactone **into L-Ascorbic acid**.
- Might have **heart- and liver-protecting benefits**.
- May **improve cholesterol levels**.
- Might **aid in cancer prevention**.
- **No reported side effects and toxicity**.

Biological Synthesis of L-Ascorbic Acid in Animal Tissues: Conversion of D-Glucuronolactone and L-Gulonolactone into L-Ascorbic acid: This paper describes a detailed investigation, covering some of the aspects mentioned above, into the mechanism of conversion of D-glucuronolactone and of L-gluconolactone into L- ascorbic acid by the liver microsomes of the rat and goat and the kidney microsomes of the chick as well as by soluble-enzyme preparations obtained from these microsomes ([Chatterjee et al., 1959](#)).

[The biological role of D-glucaric acid and its derivatives: potential use in medicine.](#)

TREHALOSE

It is a diabetic-friendly sugar. Trehalose is a disaccharide composed of two glucose molecules. **It does not raise blood insulin levels and is therefore safe for use by diabetics.**

It helps offset the sourness of the vitamin C in the product and it helps stabilize and extend the product shelf life.

Background Reference:

Trehalose: A Lesser-Known Sweetener with Untapped Health Benefits

[Author: Sheramy Tsal - *The Epoch Times*; March 21 - 27, 2024]

https://www.theepochtimes.com/health/trehalose-a-lesser-known-sweetener-with-untapped-health-benefits-5589688?utm_source=ref_share&utm_campaign=copy

Quoted from *The Epoch Times* Article:

Sweet Secret Unveiled

“Its ability to protect cells and biological molecules from damage caused by stress, such as dehydration or extreme temperature,” allows it to act “almost like a shield,” according to Ms. Chen. (Anqi Chen is an assistant professor of food science at Jiangnan University and a Cornell University doctoral graduate.)

- “Trehalose, with its low glycemic index, offers diabetic individuals a sugar alternative that doesn’t cause rapid blood sugar spikes like sucrose or glucose,”
- A [study](#) published in *Nutrition Journal* found that a daily teaspoon of trehalose “can help maintain glucose homeostasis.” ...The study concluded that trehalose “improves glucose tolerance in non-diabetic people.”
- A separate [study](#) explored how trehalose affects blood sugar, insulin levels, and certain hormones that influence digestion in healthy individuals. The study found that ingesting trehalose leads to lower blood sugar spikes and less insulin release than glucose, suggesting that it may be beneficial for maintaining stable blood sugar levels and preventing obesity-related issues.

Health Benefits Beyond Blood Sugar

- Recent [studies](#) suggest that trehalose could provide therapeutic benefits in combating debilitating neurodegenerative disorders such as Parkinson’s and Huntington’s diseases.
- Trehalose is thought to exert its protective effects primarily through [autophagy](#), a vital cellular cleanup process that removes harmful or improperly folded proteins prevalent in neurodegenerative diseases.
- Trehalose affects various cellular functions of cancer, including cell proliferation and inflammation. [Research](#) has suggested that trehalose “could potentially be employed as a novel anticancer agent.” Its role in aging, cardiometabolic disorders, and infectious diseases, including [COVID-19](#), is also under investigation.

- “Trehalose shows promise in promoting cellular health by protecting cells from oxidative stress and protein misfolding—factors associated with aging and age-related diseases,” Ms. Chen said. “It’s also been explored for its potential to boost exercise performance and endurance.”

Trehalose and Gut Health

- Trehalose is garnering attention for its potential effects on gut health, suggesting that it could significantly alter the complex ecosystem of our gut microbiome. Bacteria in the gut have their own trehalose, enabling them to harness trehalose for energy.
- While trehalose holds potential benefits for gut health, “more studies are needed to fully understand the impact of trehalose on the gut microbiome and its implications for human health,” Ms. Chen told The Epoch Times.

Dietary Considerations

- When it comes to trehalose, it is vital to recognize that the nutrients from natural sources may not always produce the same effects as those manufactured industrially. Despite trehalose’s Food and Drug Administration’s (FDA) “Generally Recognized as Safe” [status](#) and its widespread use, ongoing research is exploring how our bodies respond to synthetic versions of this sugar.
- How much to eat remains an open question. “As for optimal consumption, there isn’t a specific recommended amount of trehalose for its health benefits as of now,” Ms. Chen said.
- The FDA indicates that trehalose is well tolerated, with acceptable daily intakes of up to 100 grams. Manufacturers typically recommend a modest serving size of 5 grams—about a teaspoon—which serves as a manageable amount of sweetener to enhance the flavors of coffee, baked goods, and other food and beverages.
- “[However,] for individuals interested in incorporating trehalose into their diet for its purported health benefits, it’s advisable to consume it in moderation, primarily through natural food sources,” Ms. Chen recommended.
- “If considering trehalose as a dietary supplement or in fortified foods, it’s essential to follow recommended serving sizes and consult health care professionals, especially for those with underlying health conditions like diabetes or metabolic disorders,” Ms. Chen advised.
- With more research, new consumption recommendations are likely to emerge.

(Source: Excerpts from: *The Epoch Times* interview with Anqi Chen, an assistant Professor of food science at Jiangnan University and a Cornell University doctoral graduate)



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