NANOFORMULATED

MEMBRANE MEND®

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Membrane Mend® is a blend of phosphatidylcholine, plant-based essential fatty acids, astaxanthin, and tocotrienols designed to promote the health and resilience of cell and organelle membranes.

Supplement Facts

Serving Size: 5 mL (1 tsp.)
Servings Per Container: 20

	Amount Per Serving	% Daily Value
Natural Astaxanthin (from Haematococcus pluvialis extract)	7mg	**
DeltaGold® Tocotrienols	10mg	**
Ahiflower® (refined Buglossoides arvensis) seed oil	150mg	**
Phosphatidylcholine (from highly purified phospholipids)	460mg	**

**Daily Value not established

Other Ingredients: Water, glycerin, ethanol, tocofersolan, natural citrus oils, antioxidants (rosemary extract, natural tocopherols, ascorbyl palmitate)

EDUCATION

BIOLOGICAL MEMBRANES ARE ESSENTIAL FOR CELL AND ORGANELLE FUNCTION

Every cell and organelle in the human body is encapsulated by a biological membrane composed of orderly lipid molecules called phospholipids. Biological membranes maintain the architecture and physiology of cells and organelles and serve as the initiation point for critical intracellular signaling pathways.[1]

The cell membrane is the interface between the body's extracellular space and the complex intracellular milieu. The three most significant lipids in cell membranes are phospholipids, glycolipids, and cholesterol; phosphatidylcholine accounts for 23 percent of the lipids in cell membranes, making it an integral component of the cellular interface.[3]

Mitochondria, the minuscule yet powerful energy factories of our cells, have their own biological membranes. Intact mitochondrial membranes ensure the maintenance of mitochondrial membrane potential.[4] Factors that damage mitochondrial membranes compromise this membrane potential. Because mitochondria generate the energy necessary for every cell and tissue in the body, these organelles' structural and functional integrity is paramount.

The endoplasmic reticulum (ER) is a network of membranous tubules studded with ribosomes involved in protein and lipid synthesis. The ribosomes are tiny particles consisting of RNA that synthesize polypeptides and proteins. The ER is intrinsically involved in the synthesis of steroid hormones, including estrogen and testosterone.

The Golgi apparatus is a complex set of folded membranes inside the cell involved in the transport, modification, and packaging of proteins and lipids. It synthesizes the peptide-based fibers of the intracellular matrix. Like mitochondria, the ER and Golgi apparatus are encased in phospholipid membranes.

THE MODERN LIFESTYLE COMPROMISES MEMBRANE INTEGRITY

A variety of modern-day factors disrupt the integrity and health of biological membranes. Anthropogenic pollutants, such as particulate matter, pesticides, and heavy metals damage mitochondrial membranes, impairing ATP production.[5,6] Environmental toxins also damage the delicate lipid membranes of the endoplasmic reticulum. A growing body of research indicates that ER damage is a significant contributor to chronic disease processes, including cardiometabolic and neurodegenerative diseases.[7,8] Other aspects of the modern lifestyle, including antibiotic use and non-native electromagnetic fields disrupt cell and organelle membranes.[9,10]

THE THERAPEUTIC POTENTIAL OF SUPPLEMENTAL MEMBRANE LIPIDS

Membrane lipid therapy aims to normalize and optimize membrane lipid composition and support healthy cellular function by supplying supplemental membrane lipids to replace damaged lipids. Supplemental phosphatidylcholine (PC) is the cornerstone of membrane lipid therapy.

MEMBRANE LIPID THERAPY OPTIMIZES ENERGY PRODUCTION

The mitochondrial membrane potential is a proton electrochemical gradient across the inner mitochondrial membrane that produces the potential energy necessary to create ATP, our cellular energy "currency."[11] PC is an essential element of mitochondrial membranes, and damage to these membranes disrupts the membrane potential and ATP production. Membrane lipid therapy repairs mitochondrial membranes, restoring the membrane potential and energy production while reducing fatigue.[12]

SUPPLEMENTAL PC PROMOTES DETOXIFICATION & PROTECTS THE LIVER

Phosphatidylcholine solubilizes bile acids, ushering toxins out of the body via the stool. PC also offers hepatoprotective effects, guarding the liver against anthropogenic toxins, such as solvents, as well as the deposition of hepatic fat triggered by the pro-inflammatory Western diet and lifestyle.[13,14]

MEMBRANE LIPID THERAPY IMPROVES INTESTINAL BARRIER FUNCTION

Intestinal epithelial cells harbor membranes enriched in phosphatidylcholine.[15] A variety of inflammatory triggers, including NSAIDs and the Western diet, may disrupt intestinal epithelial cell membranes, compromising gut health.

Emerging research indicates that membrane lipid therapy may reduce gut inflammation in inflammatory bowel disease, reverse increased intestinal permeability (aka "leaky gut") and protect the gastrointestinal mucosa from pathogens such as *Helicobacter pylori*.[16,17,18]

SUPPLEMENTAL PHOSPHOLIPIDS BOLSTER BRAIN FUNCTION

As we age, the composition of our neuronal membrane lipids changes, adversely affecting neuronal signaling. Supplemental phosphatidylcholine may support healthy neuronal membranes, improving neurotransmission and protecting brain function as we age.[19] Supplemental phospholipids may also aid recovery from traumatic brain injury (TBI) by replacing oxidized lipids in neuronal membranes, improving neuronal function.[20]

SUPPLEMENTAL PC MAY SUPPORT HORMONE SYNTHESIS

The smooth endoplasmic reticulum is the site of hormone synthesis, including that of testosterone, estrogen, and thyroid hormones.[21,22] Without intact ER membranes, hormones cannot be synthesized in adequate amounts. Restoration of ER membranes with supplemental PC may thus improve hormone synthesis and secretion.

ESSENTIAL FATTY ACIDS OFFER ADJUNCT SUPPORT FOR HEALTHY MEMBRANES

Phospholipids aren't the only lipid molecules that support healthy biological membranes; essential fatty acids (EFAs) also play vital roles in membrane health. Linoleic acid (LA), alpha-linolenic acid (ALA), gamma-linoleic acid (GLA), and stearidonic acid (SDA) work together to support the health and function of cell membranes while also

reducing inflammation. LA and GLA are omega-6 fatty acids, or polyunsaturated fatty acids with their first double bond in the n-6 position. ALA and SDA, on the other hand, are omega-3 fatty acids.

While both omega-6 and omega-3 fatty acids are essential, a delicate balance between these two fats must be achieved to promote optimal membrane health and function. Buglossoides arvensis seeds contain an oil that provides an optimal ratio of omega-6 to omega-3 fatty acids that has been shown to increase circulating and tissue levels of omega-3 fatty acids.[23,24]

MEMBRANE-TARGETED ANTIOXIDANTS SUPPORT CELL AND ORGANELLE HEALTH

Defects in biological membranes trigger oxidative stress. Oxidative stress is a hallmark of numerous disease processes, including metabolic syndrome, cardiovascular disease, and chronic fatigue syndrome. While supplemental phospholipids supply the raw materials needed to restore healthy cell membranes, membrane-targeted antioxidants are equally crucial for protecting delicate membrane phospholipids against oxidative stress.

Carotenoids are vitamin A precursors and natural pigments that impart vegetables and fruits with yellow, orange, and red colors. While β-carotene is the most well-known carotenoid, it is but one of more than 750 carotenoids that have been characterized to date. Astaxanthin is a carotenoid abundant in marine life, including krill, shrimp, wild salmon, and certain microalgae species that confer these organisms with a rich pink color. Unlike β-carotene, astaxanthin cannot be converted into vitamin A. However, it is a potent lipid-soluble antioxidant that supports biological membrane integrity, protecting delicate membrane phospholipids against oxidative stress.[25] It has a particular affinity for mitochondrial membranes, where it squeezes itself in-between phospholipids to provide frontline protection against oxidative stress. The absorption of astaxanthin is increased when it is consumed with omega-3 rich oils. The absorption of astaxanthin is increased when it is consumed with omega-3 rich oils.

Astaxanthin has secondary effects beyond its antioxidant potential. It activates AMPK, an evolutionarily-conserved pathway present in all complex life forms that is a central regulator of metabolism and energy and an exquisite nutrient sensor. It also promotes mitochondrial biogenesis, upregulates tight junction proteins, and protects the kidney against inorganic mercury toxicity.

Tocotrienols are compounds within the vitamin E family with powerful antioxidant properties. Delta tocotrienol is a highly bioavailable form of tocotrienol that quenches free radicals with membrane-damaging potential, supporting membrane integrity.

Quicksilver Delivery Systems® improve upon liposomal and emulsification technology with smaller, more stable particles made from the highest-grade ingredients available. In addition to exceptional absorption rates, these tiny liposomal and nanoemulsified particles increase diffusion across mucous membranes, enhance lymphatic circulation of nutrients and support cellular delivery.