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REPORT

Benfotiamine

European Supplement Protects Against Diabetic Complications

By Dale Kiefer



When treating diabetes, today's doctors focus on establishing blood glucose control, but often overlook the need to protect against common diabetic complications such as blindness, stroke, endothelial dysfunction, and loss of limb.¹

Fortunately, benfotiamine, a little-known fat-soluble form of vitamin B1, has been shown to help prevent the development and progression of many diabetic complications. As a result, benfotiamine has become a critical nutrient for those seeking to ward off the potentially lethal impact of sustained high blood sugar levels.

Used for decades in Europe as a prescription medication, benfotiamine ameliorates the progression of diabetic nerve, kidney, and retinal damage, and relieves the painful symptoms of diabetic neuropathy.²⁻⁸ Diabetic neuropathy makes it difficult for nerves to carry messages to the brain and

also impairs the function of the microvasculature (tiny blood vessels) in the extremities. The result of this pathological blood-vessel damage is numbness and painful tingling in the feet (and hands) that can eventually result in amputation of the lower extremities.

Benfotiamine acts through a novel mechanism, blocking the biochemical pathways by which high blood sugar damages cells throughout the body.⁸ Now available as a low-cost dietary supplement, benfotiamine can help diabetes sufferers protect their nerves, kidneys, eyes, blood vessels, and heart. Benfotiamine's multifaceted effects in preventing dangerous diabetic complications make it an essential supplement for people with elevated blood sugar levels.

BENFOTIAMINE DIFFERS FROM CONVENTIONAL DIABETES DRUGS

Diabetes drugs are among the most widely prescribed pharmaceuticals on the market today. Current medications for type II diabetes seek to reduce the dangerous buildup of excess sugar (glucose) in the bloodstream by either increasing insulin production or enhancing its effectiveness.

Benfotiamine is one of the most effective yet overlooked treatments for preventing the debilitating complications of diabetes. Benfotiamine is a chemical sibling of the essential nutrient thiamine (vitamin B1). Thiamine helps to convert fats and carbohydrates into glucose, a form of fuel for the body. As such, thiamine is essential for the proper regulation of glucose metabolism.⁹

However, while thiamine is soluble only in water, benfotiamine is fat soluble, a characteristic that allows it to enter cells far more readily than thiamine and thus help to prevent diabetes-related dysfunction within the cells. This enhanced bioavailability makes benfotiamine particularly effective in treating hyperglycemia-related damage to tissues and organs.¹⁰⁻¹²

BENFOTIAMINE'S BIOCHEMICAL RESPONSE TO HIGH BLOOD SUGAR

Diabetes treatments that seek to increase insulin output or improve the cells' response to insulin do not provide adequate protection against the many complications of the disease. While diabetes medications help tackle the problem of inordinately high levels of plasma glucose, only benfotiamine reduces elevated levels of intracellular glucose and alters the body's biochemical response to the toxic breakdown products of excess sugar. Benfotiamine stimulates the production of transketolase, a naturally beneficial enzyme that efficiently converts these potentially toxic glucose breakdown products into harmless compounds that can be safely eliminated by the body.



Numerous studies have shown that benfotiamine inhibits three major pathways that lead to the formation of toxic substances such as advanced glycation end products (AGEs).^{5,8,13}

AGEs have been implicated in the development and progression of numerous disorders in diabetics. These include:

- Cardiovascular disease¹⁴
- Diabetic neuropathy (nerve disorders)^{15,16}
- Retinopathy (affecting vision)^{15,16}
- Peripheral vascular disease (affecting blood vessels of the extremities)^{15,16}
- Nephropathy (kidney disease).^{15,16}

Interestingly, AGE-associated damage to the cardiovascular system is also seen in aging adults without diabetes. In fact, aging itself is considered a major risk factor for the development of cardiac dysfunction, due to the accumulation of AGEs over time, even in non-diabetics. AGEs are believed to act through several mechanisms to promote vascular damage, scar tissue formation, and inflammation.¹⁴ Unfortunately, this process is simply accelerated in diabetics,¹⁷ which suggests that even non-diabetics can benefit from benfotiamine's ability to inhibit AGE formation.

Years of use as a prescription drug in Europe have shown that benfotiamine is safe and well tolerated.^{3,6,7,18,19} Now that it is available in the United States as a low-cost dietary supplement, researchers are turning their attention to benfotiamine and uncovering evidence that it helps to offset the dangers of numerous complications of diabetes and high blood sugar.

BENFOTIAMINE PROTECTS DELICATE NERVE AND BRAIN TISSUE

The nervous system can suffer in numerous ways from the damaging effects of high blood sugar. Comprising brain, spinal cord, and peripheral nerves, the nervous system controls the functions of muscles and organs, coordinates thoughts and actions, and conveys sensory information.

Neuropathy, or nerve disease, is one of the most prevalent and painful complications of diabetes. Characteristics of diabetic neuropathy include:

- Damage to the peripheral nerves of the extremities
- Pain that may be unresponsive to conventional pain relievers
- Numbness and altered sensation affecting the limbs
- Nerves of the extremities may malfunction simultaneously, causing polyneuropathy.

Clinical trials demonstrate that benfotiamine effectively relieves diabetic polyneuropathy. A recent random, double-blind study in Germany found that diabetes patients with polyneuropathy who supplemented with 100 mg of benfotiamine four times daily for three weeks demonstrated statistically significant improvement in nerve function scores. A decrease in pain was the most pronounced effect noted. The study authors said their findings support the results of two earlier randomized, controlled trials, which also found evidence of benfotiamine's beneficial effects in patients with diabetic neuropathy.³ Diabetes has been associated with increased oxidative stress, a contributor to many age-related disease processes. Delicate brain tissue is especially susceptible to the damaging effects of oxidative stress. As a result, diabetes is increasingly associated with cognitive decline, including dementia and Alzheimer's. (See "The Deadly Connection Between Diabetes and Alzheimer's," Life Extension, December 2006.)

A newly released study indicates that benfotiamine may protect the brain against oxidative stress associated with diabetes. Investigators experimentally induced diabetes in a group of test subjects. Following two weeks of induced high blood sugar levels, the subjects received two weeks of benfotiamine supplementation. Benfotiamine alleviated the oxidative stress in the brain that typically occurs with diabetes, leading the research team to conclude that benfotiamine may avert diabetes-induced cerebral oxidative stress through a novel mechanism.²⁰

This important finding means that benfotiamine offers critical protection for the delicate nervous system by shielding the

peripheral nerves and brain from damage caused by diabetes.

BENFOTIAMINE: WHAT YOU NEED TO KNOW

- Currently, there is no drug available to diminish the toxic effects of the breakdown products of excess glucose.
- Long used as a prescription drug for diabetes in Europe, benfotiamine is now readily available as a dietary supplement in the US. A fat-soluble derivative of vitamin B1, benfotiamine works by a novel mechanism to prevent the development and progression of diabetic complications.
- Benfotiamine helps relieve polyneuropathy, pain, and dysfunction affecting multiple nerves in the extremities, while also protecting against tissue-damaging oxidative stress in the brain.
- Benfotiamine preserves healthy endothelial function, which is associated with optimal cardiovascular health and protection against diabetic peripheral vascular disease. Benfotiamine also supports the function of muscle cells in the heart.
- Benfotiamine protects the kidneys against oxidative stress and loss of filtering capability, thus helping to prevent diabetic kidney disease.
- Benfotiamine helps prevent or delay the development of diabetic retinopathy, a cause of vision loss.

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BENFOTIAMINE OPTIMIZES ENDOTHELIAL AND VASCULAR FUNCTION

In clinical studies from around the world, benfotiamine has repeatedly demonstrated remarkable effects in normalizing endothelial function.



Endothelial cells line the interior of blood vessels. These specialized cells are commonly damaged by high blood sugar and diabetes. When blood vessels are unable to relax and dilate in response to increased blood flow demands, the result is the dangerous condition known as endothelial dysfunction. Endothelial dysfunction is believed to contribute to the initiation of atherosclerosis and to underlie much of the damage associated with the complications of diabetes, particularly peripheral vascular disease.

Peripheral vascular disease occurs when blood flow through arteries in the arms and legs is impaired. Dangers of peripheral vascular disease include:

Impaired blood flow to the extremities that can cause cramping pain with walking (intermittent claudication)

- Cuts or abrasions on the feet that fail to heal
- Ulcers and gangrene of the feet and legs that can necessitate amputation.²¹

German scientists recently investigated benfotiamine's effectiveness in supporting healthy endothelial function and peripheral blood flow. In the study, diabetic patients consumed a meal containing large amounts of advanced glycation end products (AGEs) derived from foods cooked at high temperatures. AGEs are known to contribute to endothelial dysfunction. The subjects ate the AGE-rich meal both before and after three days of treatment with benfotiamine. Indicators of endothelial function, oxidative stress, and AGEs were measured after an overnight fast on the test days, and at two, four, and six hours after the test meals.²²

The AGE-rich meal alone produced several harmful changes, including:

- Significantly decreased blood flow to the extremities
- Increased blood markers of endothelial dysfunction
- Elevation in oxidative stress
- Higher levels of AGEs.²²

The detrimental changes caused by the AGE-rich meal alone were completely prevented by supplementation with benfotiamine. Benfotiamine promoted numerous improvements, including:

- Enhanced blood flow in the extremities
- Improved endothelial function
- Diminished oxidative stress
- Normalization of AGE levels.²²

This important German study demonstrates that AGEs directly contribute to vastly diminished vascular function in diabetics, and that the use of benfotiamine prevents AGE-induced endothelial dysfunction, impaired blood flow, and increased oxidative stress.²²

Two recent studies from Italy validate benfotiamine's ability to support healthy endothelial function, even in the presence of high blood glucose levels. Independent Italian research teams showed that, in addition to preserving mature endothelial cells lining blood vessels, benfotiamine also protects endothelial progenitor cells, or cells that develop into endothelial cells. These progenitor cells are crucial to the repair and maintenance of healthy endothelial tissue.^{23,24} While hyperglycemia, or high blood sugar, interferes with the normal development of progenitor cells, the Italian scientists noted that normal development of these

cells can be restored by the administration of benfotiamine.²³ Similarly, benfotiamine inhibited human epithelial progenitor cell death, which is caused by high glucose levels.²⁴

Benfotiamine's ability to support the health of endothelial cells may have important implications in helping people to avoid peripheral vascular disease. Scientists now believe that the endothelial dysfunction that occurs with diabetes can easily lead to diabetic peripheral vascular disease.¹⁶

Japanese researchers found that peripheral arterial disease affecting the legs' blood vessels commonly occurs together with endothelial dysfunction. As a result, the legs do not receive the critical supply of blood and oxygen they need to stay healthy and functional.²⁵ Moreover, diabetic patients with peripheral arterial disease have fewer circulating endothelial progenitor cells, which are necessary to keep blood vessels functioning optimally so they can deliver blood to the limbs.²⁶

In a model of peripheral vascular disease, benfotiamine improved endothelial function, which restored circulation to the legs and increased blood and oxygen supply to the tissues. This is especially important in keeping the limbs healthy and avoiding amputation, an all-too-common consequence of vascular dysfunction. Additionally, benfotiamine reduced the diabetes-induced deficit in endothelial progenitor cells, which led to improved healing responses in the legs of diabetic subjects.²⁴

DIABETES UNLEASHES A CASCADE OF DEBILITATING HEALTH COMPLICATIONS

Diabetes is one of today's most challenging health afflictions, owing to its explosive growth, devastating effects on the body, and the difficulty of effectively treating the disease and its complications.

In a healthy person, food is converted into glucose, which is subsequently absorbed into the bloodstream. In response to this increase in plasma glucose, the pancreas secretes the hormone insulin, which shepherds glucose molecules into the body's cells, where they are stored or burned for energy.

In pre-diabetic and diabetic individuals, however, the cells resist insulin and the entry of glucose into the cells. When this happens, specialized cells in the pancreas known as islet cells respond by pumping out more insulin. Over time, the islet cells burn out altogether. The result is hyperglycemia, or high blood sugar, rendering the patient utterly dependent on a constant supply of pharmaceutical insulin.

Despite these challenges, most cells maintain relatively normal concentrations of internal glucose. However, certain cells—most notably endothelial cells, which line the interior of arteries and capillaries—are less capable of self-regulation. They tend to accumulate high levels of internal glucose, which they cannot metabolize efficiently. This causes intermediate glucose breakdown products to pile up, activating metabolic pathways that are implicated in the onset of diabetic complications.

Especially in the small blood vessels that feed the eyes, kidneys, and extremities, the toxic intermediates of glucose breakdown leave a wake of damage. For example, in the retina, this dysfunctional glucose metabolism may lead to blindness. In the kidneys, it may cause irreversible tissue damage, eventually leading to kidney failure. And in the extremities, it may cause vascular disease and nerve pain, possibly requiring amputation.^{8,10}

BENFOTIAMINE REDUCES HEART DISEASE RISK

Individuals with diabetes suffer from a greatly increased risk of heart disease. Benfotiamine may play an important role in strategies to protect heart health in people with high blood sugar.

A recent study conducted by researchers at the University of Wyoming gauged benfotiamine's ability to prevent heart disease in an experimental model of human type II diabetes. One group was rendered diabetic, while a second control group remained normal. Both groups received benfotiamine therapy for two weeks. Scientists then examined heart cells from both groups, assessing their ability to contract and various biochemical parameters.²⁷

As expected, diabetes was associated with increased oxidative stress, which interfered with the healthy function of heart muscle. Benfotiamine treatment alleviated many of the heart cell changes caused by diabetes, decreasing oxidative stress and restoring heart cell function. The researchers concluded that benfotiamine may guard heart muscle cells against the dysfunction associated with diabetes.²⁷

Supplementing with benfotiamine may thus be crucial in protecting the heart against the adverse effects of diabetes.

BENFOTIAMINE PROMOTES KIDNEY HEALTH

Kidney disease, or nephropathy, is one of the most dreaded complications of diabetes. When kidney function deteriorates in people with diabetes, the kidneys may no longer be able to perform their crucial task of filtering urine. As a result, diabetics with advanced nephropathy must resort to kidney dialysis or a kidney transplant. Kidney disease also increases the risk of cardiovascular disease and overall mortality.



In a 24-week study, scientists examined the effects of benfotiamine and thiamine on subjects with diabetes. Both forms of vitamin B1 produced beneficial changes in markers of kidney function and health, including:

- A 70-80% inhibition in the development of microalbuminuria, protein in the urine that serves as an early sign of kidney dysfunction
- A normalization of enzyme activity associated with protection against kidney disease
- A 50% reduction of AGE levels in the kidneys
- A reduction in oxidative stress associated with diabetes (produced by benfotiamine but not by thiamine).^{5,10}

The scientists noted that while both benfotiamine and thiamine helped prevent the kidney complications associated with diabetes, benfotiamine appears to be a superior choice due to its greater bioavailability in the body.^{5,10} This research indicates benfotiamine and thiamine may help people with diabetes safeguard the health of their kidneys and protect against the devastating consequences of nephropathy.

DAMAGING CONSEQUENCES OF VITAMIN B1 DEFICIENCY

Intake of simple carbohydrates, which the body processes mainly into glucose, automatically increases the need for dietary thiamine. As a result, people often suffer vitamin B1 deficiency when they routinely consume a high-calorie, high-carbohydrate diet with inadequate nutritional value.²⁸ Alcoholism may also lead to vitamin B1 deficiency, resulting in a condition known as Wernicke's encephalopathy.¹⁰

Other conditions that may be associated with thiamine deficiency are gastrectomy (surgical removal of all or part of the stomach) and bariatric surgery (used to treat obesity), which contribute to difficulties with nutrient absorption.¹⁰

BENFOTIAMINE HELPS TO AVERT VISION LOSS

While diabetes threatens whole-body health, the eyes are particularly vulnerable to damage. Damage to small blood vessels caused by diabetes can result in retinopathy (a disease of the eye's retina, which collects visual information) and even blindness.

Scientists in Germany discovered that administration of benfotiamine helped to prevent retinopathy in test subjects with diabetes. Study subjects who received benfotiamine for 36 weeks demonstrated completely normalized levels of damaging AGEs in the retina, leading the research team to conclude that benfotiamine may help prevent or delay the onset and progression of diabetic retinopathy.⁸

Benfotiamine appears to provide essential protection to the eyes, helping prevent vision-robbing diabetic retinopathy.

CONCLUSION

For decades, benfotiamine has been safely used as a prescription drug in Europe, where this natural vitamin B1 derivative has demonstrated efficacy in preventing many serious complications of prolonged hyperglycemia.

Consumers in America can now readily access benfotiamine as a low-cost dietary supplement. Laboratory investigations and controlled studies have confirmed that benfotiamine alleviates and may even reverse diabetic neuropathy, kidney disease, cardiac impairment, endothelial dysfunction, peripheral vascular disease, and diabetic retinopathy. With its proven ability to confer broad-spectrum support for the blood vessels, nerves, kidneys, eyes, and heart, benfotiamine should be considered a first-line defense against the debilitating consequences of diabetes and high blood sugar.

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