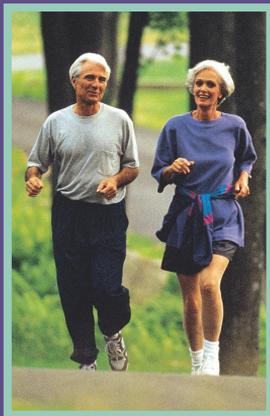
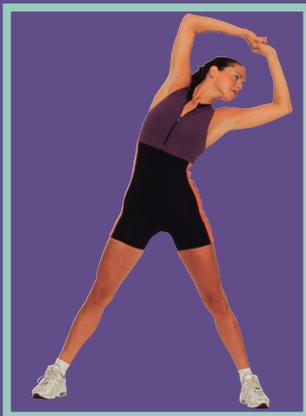
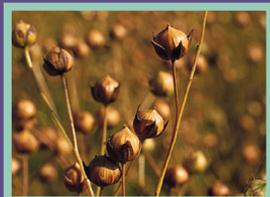
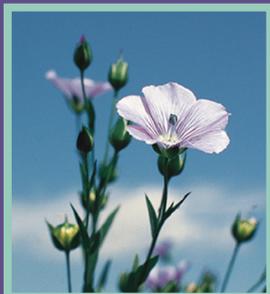


Special report: **Flax**
Lignans



Flax Lignans

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totalhealth

publisher

editor

Lyle Hurd

associate publisher

marketing director

Richard Hurd

science advisor

Parris M. Kidd, Ph.D.

associate editors

Aftab J. Ahmed, Ph.D.

Hyla Cass, M.D.

Robert Crayhon, M.S., C.N.

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editorial consultant

Elaine Alder

contributing writers

Chris Kilham

Linda Page, N.D., Ph.D.

Tina Wellman, Ph.D.

general manager

Katherine Owens

internet marketing

Lyle ("L.D.") Hurd, III

circulation manager

TJ Jones

Welcome to *totalhealth's* special report on flax lignans. The object of these reports is to offer you, a committed health food supplement consumer, cutting-edge information on nutraceutical ingredients and products which can support your personal needs.

According to the **Flax Council of Canada**, "Flax is an Ancient Crop." Flax has been grown since the beginning of civilization and people all over the world have celebrated its usefulness throughout the ages. Historians weave the magic of flax into ancient history. Records show that the human race has eaten this seed since early times.

About 3,000 B.C.

Flax is cultivated in Babylon.

Burial chambers depict flax cultivation and clothing from flax fibers.

About 650 B.C.

Hippocrates writes about using flax for the relief of abdominal pains.

In the same era,

Theophrastus recommends the use of flax mucilage as a cough remedy.

About 1st Century A.D.

Tacitus praises the virtues of flax.

About 8th Century A.D.

Charlemagne considered flax so important for the health of his subjects that he passed laws and regulations requiring its consumption.

About 15th Century A.D.

Hildegard von Bingen used flax meal in hot compresses for the treatment of both external and internal ailments.

While flaxseed has been consumed by humans for thousands of years, it is only since the last quarter of the 20th century that we have scientifically confirmed the potential as a staple in establishing and maintaining human health. Today, with significant research reinforcing the benefits of flaxseed and its derivatives flax oil and flax lignans, flaxseed is becoming one of the top-selling specialty foods and supplements on the market.

We are certain after reading the information presented by Jocelyn Mathern R.D. and Marian Verbruggen, Ph.D. you will agree that consumption of flax lignans warrants consideration by any individual committed to natural health, as well as by individuals confronted with and health care professionals who treat the conditions for which flax lignans are shown to be beneficial. □

Flax Lignans— there's more to flax than oil

by Jocelyn Mathern, R.D. and Marian Verbruggen, Ph.D.

Flax has been valued for centuries for its good flavor and nutritional properties. Today, health-conscious consumers have been raising the demand for functional foods and dietary supplements enriched with flax due to the overwhelming amount of potential health benefits. Flax is found in many forms like ground or whole seeds, oils and is also an ingredient in ready-to-eat foods such as breads, muffins and cereals. As a food, flax contains a mix of beneficial nutrients including fair amounts of fiber, both soluble and insoluble. Flaxseed oil is popular because it provides a rich, natural source of important nutrients such as omega-3 fatty acids. Flax is also rich in lignans, compounds that are increasingly being studied for their potential benefits to both men's and

women's health. Flax lignans are being hailed as one of the emerging new health ingredients. As more and more research is being completed, the scientific community continues to uncover new and exciting news about lignans.

What are lignans?

Lignans are phytonutrients found in unrefined grains, legumes, certain vegetables and seeds. Flax is the richest source of lignans, providing 70–800 times more lignans than most other plant sources (see table 1). Lignans have many biological properties. They are phytoestrogens or naturally occurring plant estrogens that can have a balancing effect on hormones. Lignans also exhibit strong antioxidant activities.

The main lignan in flaxseed is the plant lignan secoisolariciresinol diglycoside (SDG). Technically

plant lignans are precursors of mammalian lignans.

When flaxseed is eaten, SDG is converted by bacteria in the colon to mammalian lignans: enterolactone and enterodiol. This is important because the mammalian lignans are the forms of SDG that exert health effects in the body. The amount of enterolactone and enterodiol found in the blood and urine of humans and animals is related to the amount of plant lignans eaten. Large intakes of flaxseed (and SDG) will result in large amounts of enterodiol and enterolactone excretion.

Research suggests that lignans may be protective of men against prostate conditions and in the women's health arena they are being studied for bone health benefits, their protective effects against breast

cancer and for reducing symptoms of menopause. Other conditions where lignans are studied for potential benefits include heart health,

endometrial and prostate cancers. Western populations tend to consume low-fiber, high-fat diets and have a higher risk of these cancers.

lignans missing from the oil, their many health benefits are not being utilized. Flax oil containing added lignans has been available for several years

Lignan Content of Selected Foods

(SECO content of selected foods—100 gram dry weight)

Oil, seed and nuts

Flaxseed	370,000
Peanut	298
Caraway seed	221

Berries

Strawberry	1500
Cranberry	1054
Red raspberry	139

Grains and cereals

Barley	58
Rye	47
Oats	13

Fruits

Banana	3040
Guava	700
Cantaloupe	184

Legumes

Soybean	273
Kidney bean	153

Vegetables

Broccoli	414
Garlic	379
Carrot	192

Source: Adapted from Mazur W. *Bailliere's Clin Endocrin Metab.* (1998). Vol. 12 pp. 729–42.

colon cancer, hair loss, acne and inflammation. Population studies of diet and disease risk suggest an anticancer role for lignans and other phytoestrogens.

Populations with high intakes of phytoestrogens—such as the Japanese and Chinese (who typically consume a low-fat, high-fiber diet rich in isoflavonoids from soybeans and lignans from vegetables and grains), have lower incidence and mortality rates of breast,

Population differences can be seen in plasma levels of isoflavonoids, which are higher among Japanese men than European men and in urinary levels of mammalian lignans and isoflavonoids, which are higher among vegans and lactovegetarians than omnivores.

It is important to understand that most flaxseed lignans are removed during processing and thus are not found in appreciable quantities in flaxseed oil. With the

but adding SDG to flax oil is like mixing oil and water—because SDG is not soluble in oil, it doesn't mix with the oil and settles at in the bottom of the container. However, commercial methods for extracting, purifying and micronizing the lignans in flax are now available, making it possible to integrate lignans into flax oil and incorporate them in functional food products for people to enjoy while reaping their health benefits □

Flax Lignans for Women's Health

Menopause

Flax lignans provide significant health benefits for women. Because lignans are phytoestrogens, they have the potential to help reduce symptoms of menopause. One study found that 40 grams of crushed flaxseed per day was as effective as HRT in alleviating mild menopausal systems.

Breast Health

Early research also suggests lignans may protect against hormone related cancer such as breast cancer. Protective effects have been shown in rats fed flaxseed or purified SDG from flax. As previously discussed, SDG is the main lignan found in flaxseed and when consumed is converted to mammalian lignans, enterolactone and enterodiols, that are responsible for administering the many health benefits to the body.

Studies in humans are also suggestive of protective effects but are not conclusive at this point. Observation studies have found that breast cancer patients and people at high risk of breast cancer excrete less mammalian lignans than people with a lower risk of breast cancer. A study in Finland found that women with high enterolactone levels in their blood had a lower risk of breast cancer. High levels of enterolactone (a mammalian lignan) indicate increased dietary intake of plant lignans, such as SDG. These studies suggest that eating a diet rich in lignans may be protective against breast cancer.

A recent human clinical trial examined the effects of flaxseed on estrogen metabolism in 28 postmenopausal women. Researchers looked at two pathways of estrogen metabolism

involving the production of different estrogen metabolites. The ratio of these metabolites is used as a marker for breast cancer risk. The women were given 0, 5 or 10 grams of ground flaxseed a day for seven weeks. Those who ate flaxseed had an improved ratio of estrogen metabolites, suggesting that flaxseed has protective effects against cancer



in postmenopausal women. The higher doses of flax led to a greater positive response. A similar study was carried out, this time in 16 premenopausal women. Again ten grams of flaxseed per day was given and found to improve the ratio of estrogen metabolites, suggesting a chemoprotective effect in premenopausal women.

A preliminary study of 39 women with newly-diagnosed breast tumors examined the effects of flaxseed on breast cancer growth. Women were randomized to eat daily a muffin containing 0 or 25 grams of flaxseed for a little over a month. The women who ate flaxseed muffins demonstrated reductions in breast cell proliferation and tumor growth at a rate similar to effects seen with tamoxifen (a breast cancer drug) treatments.

Authors of the above studies indicate that lignans played a role, although it was not directly proven that lignans were the only compounds pro-

ducing the beneficial effects. However, lignans have been shown to inhibit estrogen-stimulated growth of breast cancer cells in a test tube. In addition, purified lignans from flax (SDG) were shown to inhibit tumor growth in rats. These results suggest that lignans do play a significant role in the anticancer activity of flaxseed. These studies discussed are not concrete proof that women who eat flaxseed are less likely to get breast cancer. However, evidence is accumulating that lignans do contribute to breast health.

Flax lignans may promote breast health by acting as a phytoestrogens and also by acting as antioxidants. In addition, research also suggests that flax and its lignans may decrease angiogenesis or the growth of blood vessels that supply oxygen and nutrients to tumors for growth.

Bone Health

Research further indicates that lignans may promote and support bone health. It is known that hormone

deficiency is a risk factor for osteoporosis in postmenopausal women. As phytoestrogens, lignans are reported to possess both weak estrogenic and antiestrogenic activities and may be a natural alternative for women in preserving bone health. A study to examine the effects of flaxseed on bone metabolism in postmenopausal women who were not on hormone replacement therapy stated that, "observations suggest flaxseed may exert positive effects on bone metabolism by reducing the rate of bone reabsorption, resulting in a net bone gain." Additionally, its positive effects on bone metabolism may be through improved antioxidant status. However, in a follow-up study, there was no effect of flaxseed on bone metabolism in postmenopausal women. Therefore, more research is needed to determine whether longer term studies with lignans will have a positive influence on other bone measurements such as bone mineral density. □

Flax Lignans for Men's Health

Flax lignans have many potential benefits for men, specifically in areas related to prostate health. Because of the growing health problem a great deal of attention is being focused on benign prostatic hyperplasia (BPH). The **American Urological Association** estimates that BPH affects 50 percent of men aged 50 to 60 and up to 90 percent of men over the age of 80.

This condition can be a problem because the urethra, the tube carrying urine from the bladder to outside the body, runs through the prostate (see illustrations). A growing prostate can pinch off the urethra and cause uncomfortable symptoms, like a frequent and overwhelming urge to urinate and painful urination. The exact cause of BPH is unknown but male hormones seem to play a role. Hormones also play a role in another prostate condition—

prostate cancer, the second leading cause of cancer death among men. Estimates indicate over 350,000 American men will be diagnosed with prostate cancer and 42,000 will die of it this year. Once considered a disease of the elderly, prostate cancer is being diagnosed increasingly in men in their 40s and 50s. Fifty-nine percent of all men will experience some degree of prostate cancer in their lifetime.

In the body, testosterone is converted to a more potent form called dihydrotestosterone or DHT. Normal, healthy prostate cells require DHT for growth. However, it is thought that too much of the hormone can cause abnormal growth—leading to an enlarged prostate (BPH) or causing prostate cancer cells to divide. Therefore, prostate health depends on balanced levels of these hormones.

Medical treatment for BPH is readily available but the use of dietary supplements to manage prostate health is becoming increasingly common. Flax lignans are an example of one nutritional ingredient that can contribute to prostate health, naturally. Researchers have found that concentrations of lignans are higher in the urine and prostate fluid of populations that have a lower risk of prostate cancer. This indicates that people who eat more foods containing lignans have lower risk of prostate cancer.

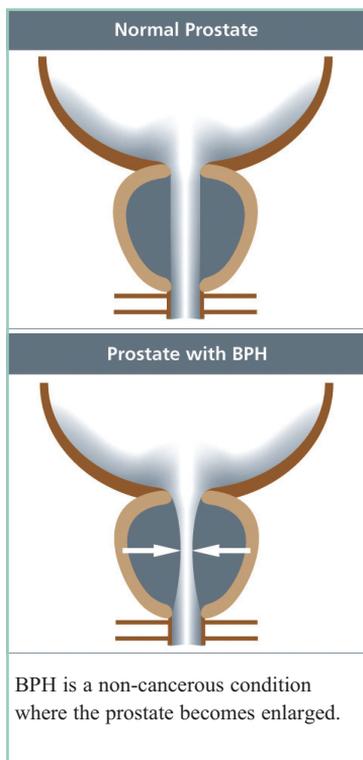
Lignans are phytoestrogens and therefore may play a valuable role in influencing hormone metabolism, including testosterone. Because testosterone and its metabolites are important in the development of BPH and prostate cancer, lignans may help maintain a healthy prostate by influencing the metabolism of these hor-

mones. In one study lignans were shown to block the action of the enzyme (5 alpha-reductase) that converts testosterone into the more potent form (DHT). Additionally, lignans have also been shown to inhibit other enzymes, which are essential for the synthesis of testosterone and estrogen. Lignans may also potentially reduce the amount of testosterone available for the body to use. In the average male, only a small amount of testosterone roams free in the blood. Most testosterone is bound to protein called sex hormone binding globulin (SHBG). An increase in SHBG would theoretically leave less testosterone available to stimulate prostate cell growth. Lignans have been shown to increase SHBG production in test tube studies and research also demonstrates that people consuming large amounts of lignans exhibit increased blood levels of SHBG.

Recently researchers at Duke University Medical School have conducted several studies looking at the effects of flaxseed on

prostate cancer. In a pilot study, 25 men with prostate cancer were given a low-fat diet plus flaxseed for 34 days. At the end of the study the men had a reduction in testosterone levels, lower rates of cancer cell growth and a trend towards lower prostate specific antigen (PSA) levels (a marker for prostate cancer). In mice, genetically programmed to develop prostate cancer, supplementation with flaxseed inhibited the growth and development of prostate cancer. These studies were done with whole flaxseed, so it is not clear how much of the effect was due to lignans. However, a study conducted using purified lignans derived from flaxseed found that the lignans inhibited the growth of human prostate cancer cells in a test tube. These findings support the concept that lignans play a role in the anticancer effects

seen in these studies. Researchers feel it is too early to conclude that eating flaxseed and its lignans will reduce the risk of prostate disease, and additional



clinical trials must be completed. But the studies completed look promising and with additional research on the health benefits of phytonutrients, like flax lignans, more evidence and options will present themselves for prostate health. □

Lignans and Cardiovascular Health

According to the Center for Disease Control:

- ♥ Heart disease and stroke—the principal components of cardiovascular disease—are the first and third leading causes of death in the United States, accounting for 40 percent of the deaths in the U.S.
- ♥ Although heart disease and stroke are often thought to affect men and older people primarily, it is also a major killer of women and people in the prime of life.
- ♥ About 16 million Americans (almost one fourth of the population) have some form of cardiovascular disease.
- ♥ Coronary heart disease is a leading cause of premature permanent disability among working adults.
- ♥ Almost six million hospitalizations each year are due to cardiovascular disease.
- ♥ The overall cost of heart disease and stroke in 2003 is estimated to be \$351 billion.

With these staggering statistics, it is no wonder that people are interested in natural products that may promote heart health. Cardiovascular disease is the result of atherosclerosis, in which deposits of cholesterol and other substances accumulate and form plaque on artery walls. Plaque build-up can gradually narrow the inside of the artery, restricting blood flow. Sometimes plaque breaks away from the artery wall, which can cause a blood clot. A heart attack or stroke can occur when blood flow is completely blocked. High cholesterol is a risk factor for cardiovascular disease. Free radicals are also implicated in the development of atherosclerosis or hardening of the artery walls.

Today Americans are turning to more natural ingredients to maintain overall heart health and reduce risk factors to the heart. Studies suggest that the dietary fiber and certain fatty acids in flax can help reduce risks of cardiovascular disease. Research also suggests that flax

lignans play a role in cardiovascular health. Secoisolariciresinol diglycoside (SDG) is a plant lignan isolated from flaxseed. In addition to being a phytoestrogen, SDG is a strong antioxidant (which is associated with a reduced risk of atherosclerosis).

The antioxidant SDG is also metabolized to secoisolariciresinol (SECO), enterodiol (ED) and enterolactone (EL) in the body. The effectiveness of SDG in heart health could be due to these metabolites and their powerful antioxidant activity. Testing has shown these metabolites individually to deliver three times

more antioxidant potency than their precursor SDG and up to five times more potency than vitamin E.

Studies in humans have found that flaxseed taken daily can reduce total and bad (LDL) cholesterol levels, because whole flaxseed contains several heart health components (fatty acids, fiber and lignans) these studies could not tell us how much effect is due to the lignans. Recently a study was done in rabbits, using lignans (SDG) isolated from flaxseed. The object of the study was to determine the effect of the lignans on cholesterol, oxidative stress and on the

development of atherosclerosis in rabbits fed a high cholesterol diet.

Results showed that the flax lignan SDG reduced deposits of cholesterol, plaque build-up and other substances on the artery walls (atherosclerosis) by as much as 73 percent. The reduction of atherosclerosis was associated with a reduction in oxidative stress. The lignans also reduced total and bad (LDL) cholesterol. These results suggest that the heart benefits of SDG may be due to its antioxidant activity and a lipid lowering effect. □



Studies suggest that the dietary fiber and certain fatty acids in flax can help reduce risks of cardiovascular disease. Research also suggests that flax lignans play a role in cardiovascular health.

Flax Lignans for Acne

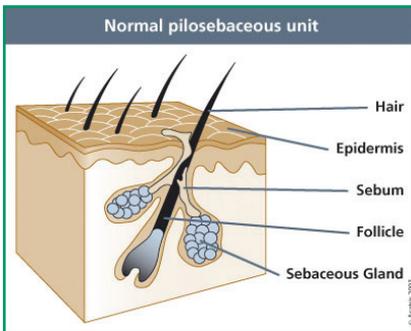
Millions of people suffer from acne, a condition affecting the pilosebaceous units of skin (see figure 1). While the cause of acne is not completely understood, heredity, hormones and bacteria all play a role. During puberty, the production of adrenal androgens is increased in both boys and girls.

been shown to correlate well with the severity of acne.

Some people are more prone to develop acne than others and family history and lifestyle can play a role. For instance the use of anabolic steroids taken by body-builders can lead to severe outbreaks.

Generally, mild acne is treated by

development of acne, hormonal therapies may be useful alternatives or adjuncts to traditional treatment. The beneficial effects of oral contraceptives on acne have been noted for several years. They are thought to exert anti-acne effects by decreasing the amount of circulating androgens. Recent research points to flax lignans as a natural alternative for the treatment of acne. Lignans have been shown to inhibit 5 alpha-reductase, an enzyme involved in the conversion of testosterone to DHT (its more active form). Inhibition of this enzyme shows promise in the treatment of a number of androgen-dependent disorders, including acne. Therefore flax lignans are of interest in the possible treatment of acne, although additional research is being conducted to confirm these findings. □



The elevation of androgens can cause an increase in sebum production, particularly in the face, chest and back (sebum is a waxy substance that helps the skin retain moisture). Excess sebum can lead to acne; the level of sebum excretion has

topical therapy. Moderate or severe acne may require topical therapy combined with oral therapy. Treatments are targeted to reduce sebum production and bacterial growth.

Since androgens (testosterone) play a role in the

Flax Lignans for Hair Loss

Another health benefit flax lignans may provide to both men and women is help with hair loss and thinning hair. According to the **American Academy of Dermatology** (AAD), the most common form of hair loss is androgenetic alopecia (AGA). The AAD states that an estimated 50 million men and 30 million women suffer from AGA, also known as hereditary hair loss, in the U.S. alone. An average of 50 percent of all population suffers from AGA by the age of 50.

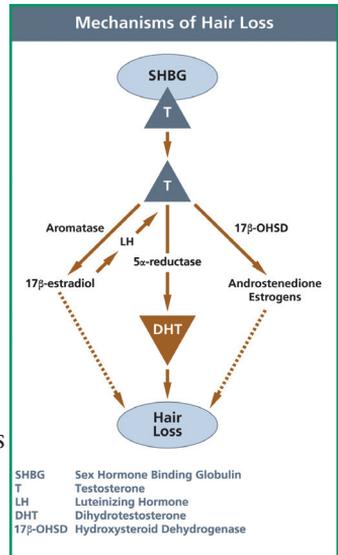
The exact cause of AGA remains unknown but an individual's level of androgens (testosterone and its metabolites) is believed to be a factor. Heredity from both male and female parents also influences an individual's predisposition to hair loss. Although hair loss is mainly associated with genetic and hormonal factors, it can also occur with illness and infectious diseases or nervous

disorders.

Hair loss occurs when hair follicles sprout hairs that are thinner than normal. Eventually the hairs become thinner and thinner and hair follicles become miniaturized.

Many treatments for AGA are being researched. Some new prescription drugs are being used for hair loss that were originally used for the treatment of prostate problems. These drugs work by blocking the formation of the male hormones that are known to cause prostate growth. These same hormones may also be a cause of hair loss. In one study, a majority of men with pattern baldness had increased production of dihydrotestosterone (DHT), a potent metabolite of testosterone. The enzyme responsible for the conversion of testosterone to DHT is 5 alpha-reductase. Therefore, inhibition of

this enzyme (5 alpha-reductase) may be beneficial in preventing or treating hair loss.



Alternative treatments and options to halt hair loss are being identified through scientific research. Natural substances like flax lignans have been shown to inhibit 5 alpha-reductase and other enzymes involved in testosterone metabolism, therefore making flax lignans of interest in the possible treatment and prevention of hair loss. □

How to Select a Lignan Rich Flax Product

Lignans in Foods and Supplements

Not all flax ingredients are created equal when it comes to lignan content.

According to the **Flax Council of Canada**, flaxseed contains between 0.7 and 1.9 percent SDG. The lignans are concentrated in the fibrous hulls of flaxseed, so processing can remove them. This is why flax oil is essentially void of lignans, although flax oil enriched with ground flax (containing lignans) is widely available. However, the amount of SDG obtained from a lignan-enriched flax oil depends on two things: how many lignans were in the flaxseed to begin with and how well the flaxseed particles mix with the oil. Flaxseed is not soluble in oil, so it resists mixing with the oil and settles at the bottom. Results of independent testing have shown a wide range of lignan content in products that are commercially available.

New Lignan Ingredients

Commercial methods for extracting lignans from flax are now available, making it

possible for food and supplement companies to add lignans to their products. Until now, consumers could never be sure of the amount of lignans in the flax products they were buying—although they knew that flax is the richest source of these beneficial compounds. Now companies will be able to make products with flax lignans and guarantee the lignan content. Today the only standardized flax lignan ingredient available is called **LinumLife™**. It is derived from flax hulls and contains the highest level of lignans available on the market—10 to 30 times more lignans than conventional flax ingredients. It was recently created to fill a void in the marketplace, after researchers realized the health benefits lignans can provide to individuals but found no lignan formulas on store shelves.

LinumLife's high lignan level makes small dosages possible for application in dietary supplements and functional foods.

How much do I need?

Currently there are no set

guidelines for lignan intake but science gives us some indication. Human clinical trials studying lignans have used 5, 10 and 25 grams of flaxseed per day, although some studies have safely used larger amounts (30 and 40 grams). One rounded tablespoon of flaxseed is equal to about 10 grams. This amount provides approximately 50 to 150 mg of lignans according to the Flax Council of Canada. Although this is a wide range, commercial ingredients, such as LinumLife, that are standardized for lignan content, will allow manufacturers to add a daily intake of 50 mg of lignans to their products more conveniently.

LinumLife is now available nationwide in a number of dietary supplements, multi-vitamins and health products. □

Where Can I Learn More About Lignans?

For more information on flax lignans visit:
www.linumlife.com
www.flaxcouncil.ca

Writer's profiles



Jocelyn Mathern, R. D., is technical specialist at Acatris Inc., a distributor of science-based, nutraceutical ingredients. Jocelyn holds a bachelor of science degree in nutrition and corporate fitness from North Dakota State University. She is currently pursuing her master's degree in nutrition at the University of Minnesota. For more information please contact joceylyn.mathern@us.acatris.com



Marian Verbruggen, Ph.D. is a food chemistry and technology industry expert with years of extensive global experience in the nutraceutical and functional food arenas. During the past five years with Acatris, Marian has worked as director of R&D. She is particularly knowledgeable in the field of phytoestrogens, including soy isoflavones and flax lignans, and works to initiate, coordinate and evaluate research projects in this area.

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