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THINOGEN[®] Fucoxanthin

YOUR CHOICE FOR WEIGHT MANAGEMENT

WHITEPAPER

ThinOgen® Fucoxanthin

Fucoxanthin is a well-known naturally occurring carotenoid from brown seaweed. Due to its ever-expanding supplement and therapeutic uses, numerous studies have revealed its many mechanisms of action. It is part of the carotenoid family classified as xanthophylls. Fucoxanthin molecule contains hydroxyl and epoxide groups, and an unusual allenic bond (Figure 1) that is believed to contribute to its anti-obesity, anti-inflammatory, anti-angiogenic and potent antioxidant protective effects.¹

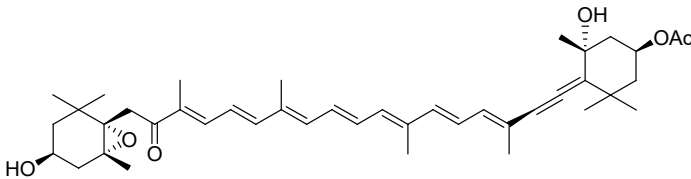


Figure 1. Chemical structure of fucoxanthin

With the increasing global pandemic of obesity, fucoxanthin has been tested in human trials, animal and cell studies to define its exact mechanisms of action.²

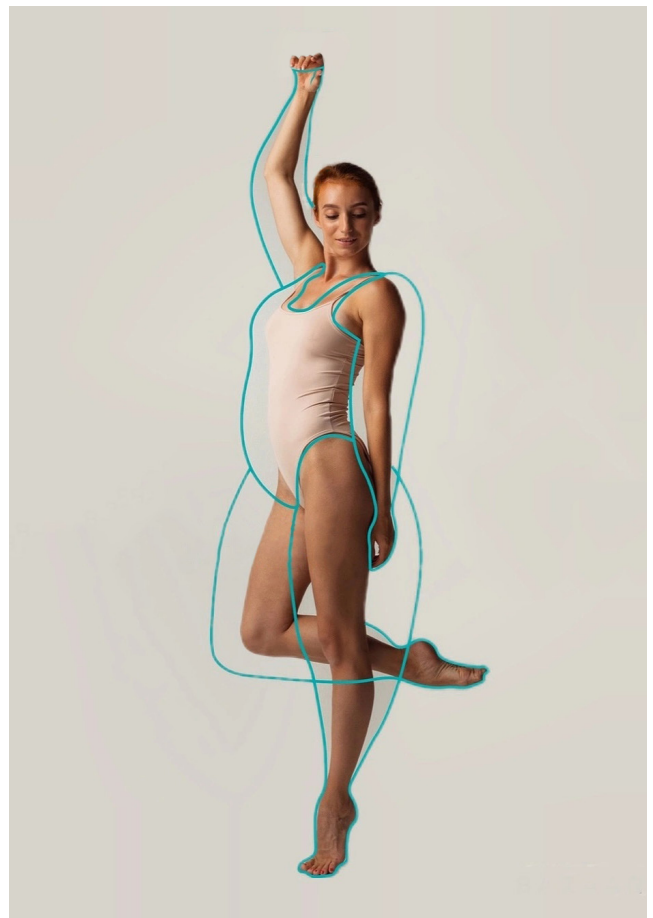
At lower doses, fucoxanthin can effectively decrease body weight, body fat accumulation and visceral fat-pad weight. Additionally, it lowers the size of adipocytes, the weight-gain of white adipose tissue (WAT), while increases the weight of brown adipose tissue (BAT) in high-fat (HF) diet-induced obese C57BL/6N mice, diabetic/obese KK-Ay mice, and C57BL/6J mice.^{3,4}

Mechanisms of Fucoxanthin's Weight Loss Effects

Fucoxanthin is entirely fat-soluble, 80% of it being absorbed into fat cells directly as fucoxanthin but more commonly as fucoxanthinol. When it enters

the fat cells it demonstrates anti-obesity properties by lowering insulin resistance by inhibiting leptin.⁵

Obesity has a long history of being associated with hyperlipidemia, i.e., increased plasma triglycerides, high LDL cholesterol and low HDL cholesterol, which is then responsible for higher blood glucose, high insulin levels and higher blood pressure. All these factors increase cardiovascular risk, especially when more than one are present.⁶



Fucoxanthin has anti-obesity effects by inhibiting adipocytic lipogenesis (fat cell formation), inducing fat mass reduction, and decreasing intracellular fat content, fat cell size, and fat cell weight as has been demonstrated in animal studies.⁷



Surprisingly, fucoxanthin changes gut microbiota to provide anti-obesity effects. In addition, fucoxanthin improved fat-induced gut microbiota irregularity by inhibiting the growth of obesity-and inflammation-associated gut microbes *Lachnospiraceae* and *Erysipelotrichaceae* species while promoting the growth of the beneficial *Lactobacillus/Lactococcus*, *Bifidobacterium*, and butyrate-producing bacteria. Similarly, the dietary supplementation of fucoxanthin in High Fat Diet-induced obese mice improved obesity, hyperglycemia, hyperlipidemia, and alleviated insulin resistance.^{8,9}

Additionally, fucoxanthin can promote the growth of intestinal flora, and intestinal microorganisms to promote the absorption of nutrients from the diet by producing enzymes that help digest certain indigestible compounds, such as xylan, cellulose, and digestion resistant starch.^{10,11}

Fucoxanthin can help alleviate liver damage caused by excessive fat accumulation by upregulating mitochondrial uncoupling protein UCP-1. Increased expression of UCP1 causes energy expenditure to avoid excessive fat accumulation and is the most important transcription factor in adipogenesis, fat cell formation.^{12,13}

It has been shown that mice fed with fucoxanthin exhibited greater synthesis of UCP1 protein in white adipose tissue, and markedly reduce white adipose tissue mass. Supplementation of the diet with fucoxanthin for six weeks reduced body weight, organ weight, fat volume, and fat cell size in obese mice **without affecting food intake.**^{14,15}

Moreover, fucoxanthin reduced lipid metabolism dysfunction and liver damage caused by a high-fat diet. It was also shown that fucoxanthin can downregulate PPAR protein and upregulate UCP1 protein in the liver in a dose-dependent manner. These effects are responsible for the improvement of HFD-induced obesity by fucoxanthin in animals.¹⁵

An additional mechanism may involve the stimulation of the Sirt1/AMPK pathway. Fucoxanthin can regulate fatty acid synthesis by significantly increasing the phosphorylation of AMP-activated protein kinase (AMPK). Fucoxanthin can also suppress the expression of factors related to fat cell formation thereby reducing lipid accumulation in liver cells.¹⁶

Fucoxanthin has a high safety profile in humans-it is the primary orange color source in brown seaweed as part of a whole food - it is mainly ingested in the brown seaweeds *Undaria* and *Laminaria* in Japan, Korea and other Southeast countries.^{17,18}

Humans can easily absorb fucoxanthin because of its small molecular weight. Additionally, it is nontoxic and exerts several beneficial biological activities in the human body. Like other carotenoids, fucoxanthin is a potent antioxidant due to its singlet oxygen-quenching ability.¹

One mouse study reported that increased mRNA expression of monocyte chemoattractant protein-1 (MCP-1) was observed in high fat (HF) mice, but was normalized in the fucoxanthin-rich lipids group: the HF-FL diet could suppress high fat (HF) diet-induced obesity in mice.¹⁹

BGG ThinOgen® Fucoxanthin

BGG ThinOgen® Fucoxanthin is produced by proprietary technology to create a highly concentrated natural fucoxanthin which is thousands times higher than wild seaweed that contains only 0.01% - 0.02% fucoxanthin, and ensures the high quality and safety of the product with minimum contaminants including heavy metals.

ThinOgen® has been the subject of human trials, animal and cell studies to reveal its varied pharmacological properties.^{20,23,24}



Human Trials with Fucoxanthin

In human trials fucoxanthin is an effective weight loss nutraceutical because it causes weight loss

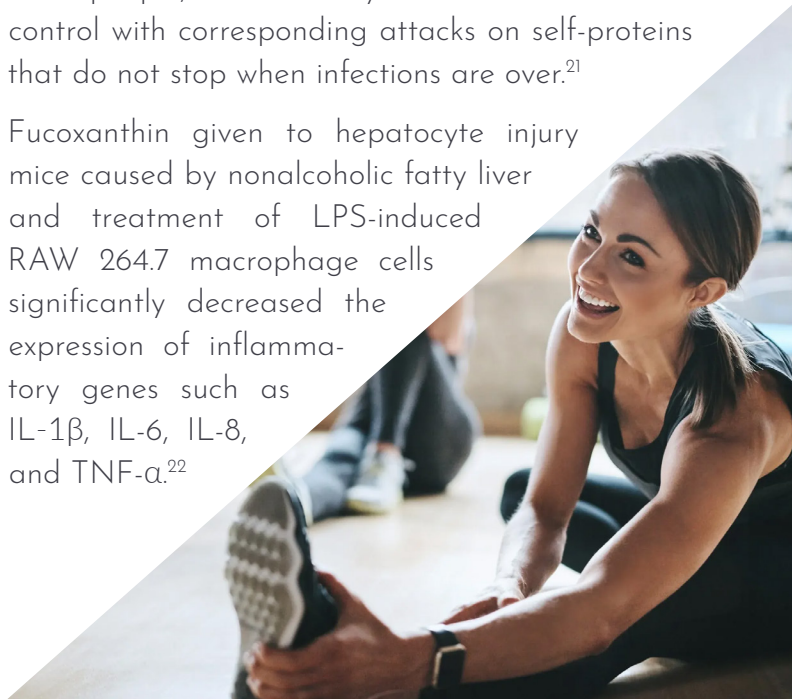
without any changes in diet or changes in exercise.

The administration of fucoxanthin to humans significantly reduced body weight in a double-blind placebo-controlled study. Capsules containing 1 and 3 mg. of fucoxanthin or a placebo were administered to mildly obese male and female adults for 4 weeks, resulting in reduced body weight, body mass index, and fat area and mass.²⁰

Fucoxanthin — Anti-inflammatory Properties

Inflammation is an essential immune response to restore the body's unstable physiological homeostasis due to various stresses, infections, injuries, etc. Despite its protective role, such responses are expected to persist for a short time without interfering with regular cellular functions. The excessive production of characteristic proinflammatory cytokines (TNF- α , IL-1 β , IFN- γ , IL6 and CCL5), mediators (PGE2, LT), nitric oxide, and free radicals, however is upregulated during the normal aging process. In some people, inflammatory factors become out of control with corresponding attacks on self-proteins that do not stop when infections are over.²¹

Fucoxanthin given to hepatocyte injury mice caused by nonalcoholic fatty liver and treatment of LPS-induced RAW 264.7 macrophage cells significantly decreased the expression of inflammatory genes such as IL-1 β , IL-6, IL-8, and TNF- α .²²



Summary

Fucoxanthin is a natural carotenoid present in marine plants like brown seaweed and microalgae. Studies showed multiple health benefits in humans and animals, including weight loss, having anti-inflammatory properties, a liver protectant, showed prebiotic activity, and is a component of whole foods consumed in Japan and Southeast Asia.

ThinOgen® is a high quality natural fucoxanthin produced from brown seaweed by proprietary technology. Clinical study on human showed that administration of ThinOgen® containing 4 mg of pure fucoxanthin per day (equivalent to 400 mg of the 1% powder form) showed significant weight loss throughout the 3 month study period, compared to the placebo group, and no side effect was found during the study and biochemical parameters in blood and urine test did not show any change throughout the trial.



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