

LE Magazine April 2007

REPORT

New Strategy to Overcome “Emotional Eating”

Virtually all weight-loss programs fail to address the multiple physiological and psychological factors that contribute to excess weight gain. A combination of novel nutrients works via multiple mechanisms to help people shed excess pounds and keep them off.

By Dave Tuttle



Even when faced with life-threatening diseases related to their corpulence, most overweight people simply cannot manage to eat less.

One overlooked reason for today's obesity epidemic is a stress-induced disorder known as “emotional eating.” Consuming certain foods, especially high-glycemic carbohydrates, bolsters “feel-good” brain neurotransmitters such as serotonin that are depleted by stress.¹ While increasing brain serotonin levels through high-carbohydrate meals can help elevate mood in the short term, ingesting ever-greater amounts of dietary carbohydrates often leads to weight gain and a cascade of ill health effects throughout the body.

To stand any chance of success, programs designed to help people reach and maintain an optimal body weight must address the multifaceted biochemical and psychological processes that contribute to excess weight gain. Fortunately, nutritional scientists have identified a combination of novel nutrients that disrupt these processes in multiple ways—suppressing brain chemicals that trigger the urge to overeat, activating hormones that convey to the brain a sense of satiety and fullness, and optimizing metabolic processes that contribute to increased fat burning and lean body mass.

In this article, we explore how these nutrients attack the multiple mechanisms that promote unwanted weight gain, and describe the results of a Life Extension clinical study designed to demonstrate their efficacy when used in conjunction with a comprehensive weight-loss strategy.

HOW EMOTIONS TRIGGER FOOD CRAVINGS

It's happened to everyone. Most of the time, we are able to successfully control our food intake. We select vegetables and fruits with a high nutritional value. We take care to consume sufficient amounts of lean protein and fiber. We balance our caloric intake with our daily caloric expenditure in a way that ensures a stable body weight. Then something happens to make us stressed or depressed—and we head straight for the Häagen-Dazs.

Scientists refer to this phenomenon as emotional eating—a way that many people cope with negative feelings like depression, anxiety, stress, and boredom. People who normally restrain their food consumption lose self-discipline when faced with stressors that seem beyond their control. This pushes them to make dietary choices that are detrimental in the long term, but that in the short term offer immediate gratification and relief (albeit temporary) from negative emotions. In fact, several studies have shown that people under chronic stress tend to gain weight over time, due to both stress-related endocrine changes and aberrant coping behaviors that center on food.

In general, scientists have found that eating a meal alters your mood and emotional predisposition, typically reducing irritability and increasing calmness.¹ A study in *Psychosomatic Medicine* confirmed that people tend to consume food in order to self-medicate their feelings of stress or anxiety.² Thirty-four men and women were told that they needed to prepare a four-minute speech that would be recorded by video equipment and later assessed by the researchers for its quality. This produced so much stress in the participants that their blood pressure increased and their mood worsened. An additional 34 volunteers served as a control group. All participants were then allowed to eat as much as they wanted of a selection of foods. The outcome? The stressed group consumed 88% more sweet, fatty food than did the control group. Another study found that the most important psychological variable that determines how much ice cream people consume is their tendency toward emotional eating.³

The winter holidays often make emotional eating even worse. According to a recent survey by the American Psychological Association, 41% of women eat for comfort during the holidays, compared to 31% who do so during the rest of the year.⁴ Among men, 25% report comfort eating over the holidays, compared to 19% who do so the rest of the year. These results are closely related to stress levels: 44% of women and 31% of men report increased stress during the holiday season. Clearly, increasing one's food consumption is a very common coping mechanism for both men and women.



Scientists believe these choices are not made solely because of the pleasing taste of these foods. Carbohydrate-rich, protein-poor meals allow greater uptake of the amino acid tryptophan into the brain, where it serves as a precursor for synthesis of the brain neurotransmitter known as serotonin.⁵ Consuming these foods can also relieve stress by stimulating the release of brain opioids known as endorphins, which induce a sense of pleasure, and dopamine, another brain neurotransmitter that underpins the positive reward system, including the anticipation of pleasure.^{6,7} While this eating strategy may be useful in reducing feelings of stress in the short term, chronic intake of these foods can lead to weight gain and other health-damaging effects.

Peptides and hormones such as cholecystokinin (CCK), glucagon-like peptide-1 (GLP-1), leptin, and peptide YY (PYY) can also influence hunger levels, sometimes triggering increased food intake—whether you need the calories or not.⁸

Successful manipulation of these neurotransmitters, hormones, and peptides can therefore help prevent episodes of emotional eating, reducing the impact of a stressful lifestyle on your waistline. In the long run, continued management of these variables can ensure that you are able to achieve and maintain a healthy body weight that will contribute to a longer life.

As health-conscious adults seeking to live long and productive lives, we need to learn how to manipulate these signals our brains receive in a way that will allow us to control our caloric intake. Life Extension's scientists have identified three critical nutrients—green oat extract, pinolenic acid, and conjugated linolenic acid (CLA)—that can help us achieve this goal. These nutrients work together to promote satiety—the condition of being full to the point of satisfaction—while reducing the tendency toward emotional eating, enabling us to adhere to a healthy diet that promotes health and longevity.

GREEN OAT EXTRACT INHIBITS TROUBLESOME BRAIN CHEMICALS

One natural product that has shown great promise in easing emotional stress and nervous energy is green oat extract. This botanical agent positively influences your brain chemistry by increasing the action of two chemical messengers that enhance positive feelings, helping you to resist tempting foods. Its invigorating actions also promote a sense of well-being that can help strengthen your will power to follow a healthy diet and lifestyle program.

Wild oat (*Avena sativa*) has been used for thousands of years as both a food and medicinal agent. As early as the Middle Ages, herbalists recommended green oat to enhance mood and promote a sharp, clear mind. In the past decade, the German Commission E Monographs—a leading authority on modern herbal medicine—noted that this botanical remedy helps reduce stress, anxiety, and tension. Green oats are also considered useful as a tonic and restorative remedy to treat nervous exhaustion.⁹

Today, scientists are uncovering the mechanisms by which green oat extract works to relieve stress and promote well-being. Laboratory studies have found that wild oat extract significantly inhibits two enzymes that are closely related to mood states: monoamine oxidase B (MAO-B) and phosphodiesterase-4 (PDE4).^{10,11} MAO-B is responsible for the breakdown of dopamine, and drugs that lessen its activity are frequently used to treat symptoms of depression.¹² Inhibiting PDE4, on the other hand, helps to boost levels of cyclic AMP (cAMP), an important secondary chemical messenger in cells.¹³ This may help promote the positive feelings that can decrease emotional eating. By promoting mental and physical resilience and reducing nervous tension, wild green oat extract thus disrupts the link between emotional stress and the urge to raid the refrigerator.

EMOTIONAL EATING AND WEIGHT LOSS: WHAT YOU NEED TO KNOW

- Despite the potentially life-threatening risks of being overweight or obese, many people find it next to impossible to limit their calorie intake in order to lose weight.
- Consuming too many carbohydrates, especially high-glycemic carbs, is known to contribute to weight gain. Few people are able to successfully avoid excess carbohydrates in the long term.
- One reason people eat too many carbohydrates is that these foods increase brain levels of feel-good neurotransmitters such as serotonin. Eating sweet, fatty foods in order to boost depressed or anxious mood is called emotional eating.
- To achieve successful weight management, it is necessary to overcome the tendency toward emotional eating, while promoting feelings of satiety and inhibiting the body's tendency to store calories as fat.
- A novel extract of wild green oat boosts feelings of well-being while strengthening resistance to emotional eating.

Derived from pine nuts, pinolenic acid demonstrates a remarkable ability to increase levels of hormones that signal the brain that you feel satiated and satisfied, leading to a decreased desire to consume more food. Conjugated linoleic acid (CLA) helps promote weight loss while optimizing fat burning and increasing lean body mass.

- In a human clinical trial, the combination of green oat extract, pinolenic acid, and CLA has demonstrated outstanding efficacy in promoting significant weight loss.

REPORT

New Strategy to Overcome “Emotional Eating”

Virtually all weight-loss programs fail to address the multiple physiological and psychological factors that contribute to excess weight gain. A combination of novel nutrients works via multiple mechanisms to help people shed excess pounds and keep them off.

By Dave Tuttle

PINOLENIC ACID DECREASES HUNGER AND INCREASES SATIETY

Overeating is a common result of stress and heightened emotions. When you are feeling down or frenzied, sugary or fatty foods often hit the spot. To limit your intake of these high-calorie foods, you need to send your brain hormonal signals that you have eaten enough. The oil of the Korean pine nut contains a nutrient known as pinolenic acid that enables you to do precisely that.

The process of eating triggers specific reactions in the body that suppress appetite cravings in the brain. For example, during digestive processes, the intestines release satiety hormones such as cholecystikinin (CCK) and glucagon-like peptide-1 (GLP-1). These circulating hormones convey information about food intake and appetite to the brain pathways that control eating.



CCK is produced in response to partially digested food (called chyme) and certain fibers leaving the stomach to enter the small intestine. CCK slows down gastric emptying and reduces appetite and food intake.¹⁴ It also stimulates the contraction of the gallbladder, releasing bile needed to emulsify dietary fats. GLP-1 is released after a meal containing fat or carbohydrates. It also delays gastric emptying, contributing to its ability to promote satiety while reducing food consumption and appetite.¹⁵ Together, ideal levels of these two hormones can make a significant impact on the amount of food you eat, with resulting benefits for body-fat reduction.

A number of scientists have confirmed the biological functions of these hormones by infusing physiological levels of CCK and GLP-1 into the body. Two studies published in the American Journal of Physiology substantiate CCK's benefits.^{16,17} CCK was shown to increase fullness while decreasing the desire to eat. A Scandinavian study found that a GLP-1 infusion after a small

breakfast increased feelings of satiety and fullness so much that food intake at an unrestricted lunch dropped by 12%.¹⁸ However, there is evidence that obesity down-regulates the release of GLP-1, which may result in the consumption of a larger number of calories to elicit a “normal” GLP-1 satiety signal.¹⁹ This would help to perpetuate a person's weight problem unless an alternative means of boosting GLP-1 levels could be found.

Fortunately, scientists have discovered that pinolenic acid, a fatty acid naturally found in high concentrations in the Korean pine nut, can dramatically increase CCK and GLP-1 levels. Researchers in the Netherlands conducted a double-blind, placebo-controlled clinical trial on 18 overweight women in their fifties.²⁰ All 18 volunteers fasted overnight, and then half took 3 grams of a pine nut extract providing 450 mg of pinolenic acid, while the other half consumed a placebo containing olive oil. The volunteers then ate a light breakfast of two slices of bread and marmalade. The scientists drew blood and measured hormones associated with hunger, satiety, and eating behavior at baseline and thereafter at regular intervals for four hours following the initial dose. The women also provided assessments of their hunger at each interval.

Supplementation with pinolenic acid produced impressive increases in satiety hormones: total CCK production rose by 60% during the study period, while GLP-1 levels increased by 25%. Thirty minutes after taking the supplement, the participants' desire to eat had dropped by 29%, and their prospective food intake (what they planned to eat) declined by 36%. Pinolenic acid's remarkable ability to decrease hunger and diminish food intake could have profound effects for individuals seeking to limit their calorie intake.²⁰

Pinolenic acid may also benefit cardiovascular health. It has been found to lower potentially harmful low-density lipoprotein (LDL).²¹ A Japanese study demonstrated that pinolenic acid can lower blood pressure levels in animal subjects.²² Since overweight people often have elevated blood pressure and cholesterol, the use of pinolenic acid clearly offers multifaceted benefits.

CLA REDUCES WEIGHT, IMPROVES BODY COMPOSITION

Another reason why people tend to gain weight is that the body is programmed to store surplus calories as body fat. While this

made a great deal of sense when we were living in caves and often forced to go for days without food, this tendency is counterproductive today, when food is readily available around the clock. By reducing the body's tendency to store extra calories as fat and promoting fat burning, it is easier to optimize body weight and composition. In study after study, conjugated linoleic acid, commonly known as CLA, has produced these very effects, while simultaneously increasing feelings of fullness and satiety.

Conjugated linoleic acid consists of paired derivatives of linoleic acid, an unsaturated fatty acid.²³ It is found in the meat and milk products of cows, goats, and sheep. However, given the high fat content of these animal sources, supplementation with CLA is an attractive option.

Various studies have demonstrated CLA's benefits. In a clinical trial in Norway, one year of supplementation with CLA markedly reduced body fat mass in healthy overweight adults.²⁴ In this double-blind, placebo-controlled study, 180 male and female volunteers, aged 18-65, consumed either 3.6 grams of CLA or a placebo daily. They were instructed to continue with their normal dietary and exercise habits, which the researchers monitored throughout the study. Despite the fact that their diet and physical activity levels were unchanged, the volunteers taking CLA made improvements in body composition, reducing their fat mass by 8.7% while increasing their lean body mass by 1.8%. The greatest reductions were in those who had the highest body mass index (BMI) at the study's onset.

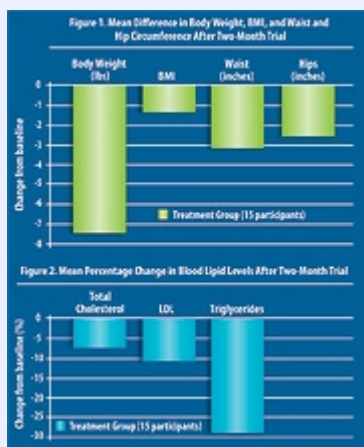


Another study demonstrated that CLA can produce body-fat reductions in only six months.²⁵ When researchers gave 3.4 grams of CLA or a placebo daily to 118 overweight and obese subjects, body fat mass in the CLA group dropped by 5.6%. It thus appears that much of CLA's benefit is obtained within the first six months of supplementation. The scientists also measured where the fat loss occurred. In women, the greatest reduction was in the legs and trunk, whereas in men, the loss was most pronounced in the trunk (including the abdomen). Waist circumference was reduced by 2 centimeters (nearly an inch), resulting in an improvement in the waist-to-hip ratio (an indicator of abdominal obesity). All these positive changes occurred without any loss of lean muscle tissue—the opposite of what takes place with most weight-loss programs.

Even better, scientists at the University of Wisconsin at Madison discovered that supplementing with 3.2 grams of CLA daily for six months prevented holiday weight gain.²⁶ While the placebo group added pounds around the middle during the holidays, those in the CLA group lost fat from August to October, and kept it off through the end of January. While CLA had no effect on physical activity, dietary intake, or resting metabolic rate, it significantly decreased the number of negative emotions reported by the subjects. Perhaps the realization that CLA kept their waists in check allowed them to enjoy the season more!

Studies suggest that CLA is effective for a number of reasons. A 13-week study found that it increased feelings of fullness and satiety, and decreased feelings of hunger, compared to a placebo.²⁷ CLA has also been shown to reduce fat uptake into the adipocytes (fat cells).²⁸ This effect is thought to promote an increased flux of fatty acids to the muscle cells, boosting the use of fat for fuel. The result would be a sparing of liver glycogen stores, which various researchers believe may contribute to satiety signals.²⁹ Some scientists also suggest that CLA-induced changes in gene expression promote apoptosis (cell death) in the adipocytes, helping to reduce the number of cells that can store fatty acids.³⁰

LIFE EXTENSION STUDY CONFIRMS THAT NUTRIENTS PROMOTE FAT LOSS



As part of its efforts to find the most successful nutrients to facilitate fat loss, Life Extension scientists conducted an open-label study in the fall of 2006. A total of 15 obese men and women completed the two-month trial, which took place at the Life Extension offices in Fort Lauderdale, Florida.

Study subjects received a nutritional supplement containing wild green oat extract, pine nut extract with pinolenic acid, and a natural safflower oil blend rich in conjugated linoleic acid (CLA).

Participants were instructed to take four softgel capsules twice daily, 30 to 45 minutes before each of their two main meals, for a total of 60 days. They were also given the option of taking the capsules between meals, if they tended to eat snacks between meals. All study participants visited Life Extension three times during the study: at registration (Day 0), Day 30 (midpoint), and Day 60 (study completion). During each visit, scientists performed

assessments of body weight, waist and hip circumference, skin fold diameter, blood pressure, capsule count (to ensure compliance with the study protocol), and a review of any side effects. Blood samples were also collected after the participants had conducted a 12-hour overnight fast. All participants received general (though no individualized) advice on an appropriate diet and exercise regimen.

The study subjects demonstrated dramatic improvements after 60 days, shedding an average of 7.5 pounds—a reduction

considered statistically significant. In addition, the subjects' body composition was markedly improved. Body mass index, waist and hip circumference, and skin folds were significantly reduced, as shown in Figure 1 at the end of this article. Life Extension researchers also found that the weight loss was associated with consistent trends for improvement in multiple critical metabolic parameters, as shown in Figure 2 at the end of this article.

Ahmed Mohamed, one of the study participants, remarked, "I had no doubts entering the study, because as a Life Extension member I knew that they use quality ingredients. I was also impressed that the testing was done every 30 days, and that the researchers looked at overall body composition, not just body weight." Ahmed, a former football player, lost 7 pounds in 60 days, without starving or depriving himself. He maintained his already vigorous exercise regimen and watched his portion sizes. "I'm always looking to get better, so I'll definitely continue with this supplement once it comes out," he noted.

TAKE CONTROL OF YOUR BODY WEIGHT!

As tens of millions of overweight Americans know all too well, today's high-stress world lends itself to the compensatory comforts of emotional eating. Try as we may to avoid them, there are times when we seemingly are driven to consume foods that gratify our emotional needs but are counterproductive to optimal health and longevity.

The good news is, modern nutritional science is uncovering strategies that can help us resist these urges. Nutrients such as green oat extract, pinolenic acid, and CLA can help reduce appetite and improve mood, supporting us in the struggle to maintain healthy eating habits. With their proven benefits of promoting fat loss and increased lean muscle mass, these nutrients can provide a decisive advantage in achieving an ideal body weight. And even if we do decide to partake in a little comfort food from time to time, the diminished hunger signals we experience as a result of ingesting these nutrients should help to keep those extra portions within reason.



PROFILES IN IMPROVED HEALTH: CARL AND LEONOR KRUSE

Carl and Leonor Kruse live only a few miles from the Life Extension offices, so they were eager to participate in the weight-loss study. Carl had volunteered for an earlier Life Extension cholesterol study, so he knew the trial would be administered in a professional manner. "Everyone was very helpful and cooperative, plus I got the benefit of the blood tests," he says.

Carl, who is 67, had never exercised regularly before, so the study requirements were a bit of a transition for him. Nevertheless, he got with the program, walking on a treadmill or doing the elliptical machine for 30 minutes every day, plus lifting light weights for 10 minutes, three times a week. He also reduced his calorie intake to 1,200 calories per day, although occasionally he would eat a candy bar, pushing the calorie count to 1,400. He even threw in a couple of 3,500-calorie splurge days when he ate restaurant-sized portions and some dessert. Even with these modest transgressions, he lost nearly half a pound per day on average.

"The supplement I took really controlled my appetite," Carl says. "The first two days I felt some hunger, but less than before. After that, I had no hunger at all." His total weight loss during the study was 24 pounds, or 10.8% of his initial body weight.

Carl lost 16 pounds during the first month, but then stopped taking the supplement for 17 days because his doctor told him he was losing weight too quickly. During those days off, he still watched his food intake and continued to exercise, but his body weight stabilized. He recalls that he was hungrier then, so it was almost impossible to keep to the dietary regimen. For the last 14 days, he went back on the supplement and lost an additional 8 pounds. In just two months, his waist shrank from 45.5 to 40 inches, his body mass index dropped from 32 to 28.7, and his blood pressure and blood sugar levels also fell.

"All the signs of metabolic syndrome declined," Carl adds. "My waist-to-hip ratio went from over 1.00 to under 1.00, and I lost body fat instead of water and muscle—in fact, I actually put on muscle!"

Carl definitely wants to go back on the supplement so he can lose an additional 20 pounds in two months. Since the study ended, however, he has experienced more hunger and is eating a bit more meat and sweets. He has also gained 4 pounds, even though he is still exercising two days a week.



Carl's waist is now smaller than his hips for the first time since he was 12 years old. "Now my only problem is that I need to buy new pants," he exclaims. "And I'm getting rid of my old pants so I won't be tempted to revert to my old patterns."

His wife, Leonor, decided to participate in the study because she gained 18 pounds while being treated with prednisone. Although she has a sweet tooth, she is also an avid exerciser. Leonor has followed the same regimen for 10 years: attending an hour-long spinning class and then doing aerobics with light weights for another hour, Monday through Friday. On weekends she relaxes, or she may go to the gym in her condo complex.

Leonor, who is also 67, consistently took the weight-loss supplement and always ate less than 1,200 calories per day. While she did not count her calories before the study began, she guesses that she used to consume more than 1,200 calories. She eliminated bread from her diet and controlled the size of her meal portions to keep her calorie count in check. Leonor was healthy before the study began, and the blood tests she took confirmed that she remained so throughout the trial.

"I felt fine during the study, but I didn't feel any hunger," she says. "Other than that, I didn't experience any side effects or sensations. This product controls my appetite, so I really want to continue with it."

SUSAN LEMIEUX

Susan Lemieux, now 47, started the study at 176 pounds and finished it two months later at 160 pounds, losing an impressive 9% of her body weight. She religiously took the supplements and walked on the treadmill for 30 minutes, five days a week. Susan keeps a very busy schedule, so she did her treadmill exercise while watching TV at home. She ate the same types of foods she has always eaten, but reduced her portion size to remain within the study's 1,200-calorie daily limit. "The pills helped me to not go overboard eating, because my hunger was less," she notes, "though toward the end of study I did feel a bit hungrier, possibly because I was getting closer to my essential body fat level, so my brain sent out more hunger signals."

The study was life changing for Susan. There were major improvements in her cholesterol readings, and her back pain—once so severe that she was a candidate for spinal surgery—was dramatically reduced. "I liked the fact that you didn't have to buy special food with this all-natural product," she says. "And the exercise really wasn't that much work, either, just a little bit every day."

"I had a very positive experience during the study," she adds. "The people administering the study were always very nice and informative, helping me out when I needed it." Susan admits that she could still stand to lose some more weight, so she plans to take the product when it comes out. "I'm very happy with the supplement and I'd recommend it to anyone," she adds.

References

1. Gibson EL. Emotional influences on food choice: sensory, physiological and psychological pathways. *Physiol Behav.* 2006 Aug 30;89(1):53-61.
2. Oliver G, Wardle J, Gibson EL. Stress and food choice: a laboratory study. *Psychosom Med.* 2000 Nov;62(6):853-65.
3. van Strien T. Ice-cream consumption, tendency toward overeating, and personality. *Int J Eat Disord.* 2000 Dec;28(4):460-4.
4. Available at: <http://apahelpcenter.mediaroom.com/idnes.php?s=pageB>. Accessed January 2, 2007.
5. Markus CR, Panhuysen G, Tuiten A, et al. Does carbohydrate-rich, protein-poor food prevent a deterioration of mood and cognitive performance of stress-prone subjects when subjected to a stressful task? *Appetite.* 1998 Aug;31(1):49-65.
6. Mercer ME, Holder MD. Food cravings, endogenous opioid peptides, and food intake: a review. *Appetite.* 1997 Dec;29(3):325-52.
7. Bruinsma K, Taren DL. Chocolate: food or drug? *J Am Diet Assoc.* 1999 Oct;99(10):1249-56.
8. Huda MS, Wilding JP, Pinkney JH. Gut peptides and the regulation of appetite. *Obes Rev.* 2006 May;7(2):163-82.
9. Blumenthal M. *The Complete German Commission E Monographs: Therapeutic Guide to Herbal Medicines.* Austin, TX:

10. Available at: <http://www.thieme-connect.com/ejournals/abstract/phyto/doi/10.1055/s-2006-954926>. Accessed January 31, 2007.
11. Wullschleger C. The rediscovery of green oat preparations to support mental health and cognitive function. *Nutraceutical Business & Technology*. 2006 May/June:30-4.
12. Jain R. Single-action versus dual-action antidepressants. *Prim Care Companion J Clin Psychiatry*. 2004;6(Suppl 1):7-11.
13. Houslay MD, Schafer P, Zhang KY. Keynote review: phosphodiesterase-4 as a therapeutic target. *Drug Discov Today*. 2005 Nov 15;10(22):1503-19.
14. Little TJ, Horowitz M, Feinle-Bisset C. Role of cholecystokinin in appetite control and body weight regulation. *Obes Rev*. 2005 Nov;6(4):297-306.
15. Naslund E, Barkeling B, King N, et al. Energy intake and appetite are suppressed by glucagon-like peptide-1 (GLP-1) in obese men. *Int J Obes Relat Metab Disord*. 1999 Mar;23(3):304-11.
16. Brennan IM, Feltrin KL, Horowitz M, et al. Evaluation of interactions between CCK and GLP-1 in their effects on appetite, energy intake, and antropyloroduodenal motility in healthy men. *Am J Physiol Regul Integr Comp Physiol*. 2005 Jun;288(6):R1477-85.
17. Gutzwiller JP, Degen L, Matzinger D, Prestin S, Beglinger C. Interaction between GLP-1 and CCK-33 in inhibiting food intake and appetite in men. *Am J Physiol Regul Integr Comp Physiol*. 2004 Sep;287(3):R562-7.
18. Flint A, Raben A, Astrup A, Holst JJ. Glucagon-like peptide 1 promotes satiety and suppresses energy intake in humans. *J Clin Invest*. 1998 Feb 1;101(3):515-20.
19. Naslund E and Hellstrom PM. Glucagon-like peptide-1 in the pathogenesis of obesity. *Drug News Perspect*. 1998 Mar;11(2):92-7.
20. Causey JL. Korean pine nut fatty acids induce satiety-producing hormone release in overweight human volunteers. Paper presented at: American Chemical Society National Meeting & Exposition; March 26-30, 2006; Atlanta, GA.
21. Lee JW, Lee KW, Lee SW, Kim IH, Rhee C. Selective increase in pinolenic acid (all-cis-5,9,12-18:3) in Korean pine nut oil by crystallization and its effect on LDL-receptor activity. *Lipids*. 2004 Apr;39(4):383-7.
22. Sugano M, Ikeda I, Wakamatsu K, Oka T. Influence of Korean pine (*Pinus koraiensis*)-seed oil containing cis-5,cis-9,cis-12-octadecatrienoic acid on polyunsaturated fatty acid metabolism, eicosanoid production and blood pressure of rats. *Br J Nutr*. 1994 Nov;72(5):775-83.
23. Wang Y, Jones PJ. Dietary conjugated linoleic acid and body composition. *Am J Clin Nutr*. 2004 Jun;79(6 Suppl):1153S-8S.
24. Gaullier JM, Halse J, Hoye K, et al. Conjugated linoleic acid supplementation for 1 y reduces body fat mass in healthy overweight humans. *Am J Clin Nutr*. 2004 Jun;79(6):1118-25.
25. Gaullier JM, Syvertsen C, Halse J, et al. Conjugated linoleic acid induces regional-specific decreases in fat mass in a 6 months clinical trial. *FASEB J*. 2006;20(5):A185.
26. Watras AC, Buchholz AC, Close RN, Zhang Z, Schoeller DA. The role of conjugated linoleic acid in reducing body fat and preventing holiday weight gain. *Int J Obes (Lond)*. 2006 Aug 22.
27. Kamphuis MM, Lejeune MP, Saris WH, Westerterp-Plantenga MS. Effect of conjugated linoleic acid supplementation after weight loss on appetite and food intake in overweight subjects. *Eur J Clin Nutr*. 2003 Oct;57(10):1268-74.
28. Choi Y, Kim YC, Han YB, et al. The trans-10,cis-12 isomer of conjugated linoleic acid downregulates stearoyl-CoA desaturase 1 gene expression in 3T3-L1 adipocytes. *J Nutr*. 2000 Aug;130(8):1920-4.
29. Flatt JP. Glycogen levels and obesity. *Int J Obes Relat Metab Disord*. 1996 Mar;20 Suppl 2S1-11.

30. House RL, Cassady JP, Eisen EJ, McIntosh MK, Odle J. Conjugated linoleic acid evokes de-lipidation through the regulation of genes controlling lipid metabolism in adipose and liver tissue. *Obes Rev.* 2005 Aug;6(3):247-58.

All Contents Copyright © 1995-2009 Life Extension Foundation All rights reserved.

LifeExtension®

These statements have not been evaluated by the FDA. These products are not intended to diagnose, treat, cure or prevent any disease. The information provided on this site is for informational purposes only and is not intended as a substitute for advice from your physician or other health care professional or any information contained on or in any product label or packaging. You should not use the information on this site for diagnosis or treatment of any health problem or for prescription of any medication or other treatment. You should consult with a healthcare professional before starting any diet, exercise or supplementation program, before taking any medication, or if you have or suspect you might have a health problem. You should not stop taking any medication without first consulting your physician.