

Super Nutrition's Fact vs Fiction

Number 2b, August, 2001



WHY FACT VS FICTION?

We are frequently asked why we use or do not use certain ingredients or forms of nutrients in our multi-vitamin formulas.

Fact Vs Fiction provides information on how we choose specific forms of nutrients.

Scientific references are cited and text from abstracts is included to provide research details.

We evaluate nutritional ingredients by the following criteria:

- 1) Is it natural and normal to the human body?
- 2) Has it had a long history of safe use in humans?
- 3) Is it supported by science and/or traditional herbal wisdom?
- 4) Is it nutritionally effective?
- 5) Is it cost-effective for our customers?
- 6) Is it concentrated enough that we can provide optimal levels to our customers in a reasonable amount of tablets?

We have no vested interest in any form of nutrient. Our selections are based on what is best for our customers' health and their pocketbook.

The Truth About Calcium Carbonate, Calcium Citrate, And "Food-Grown-Type" Calcium

Fiction: Calcium carbonate doesn't absorb well, isn't bioavailable, and doesn't build bone.

Fact: Studies verify that calcium carbonate absorbs as well as other forms of calcium, is very bioavailable and builds bone.

Fiction: Calcium carbonate is toxic. "Food-grown-type" calcium is not toxic.

Fact: Calcium carbonate has an excellent long-term record of safe use and is non-toxic at supplemental doses. "Food-grown-type" calcium may cause yeast allergies.

Fiction: Calcium citrate and "food-grown-type" calcium absorb better than calcium carbonate.

Fact: Calcium citrate absorption is equal, while "food-grown-type" calcium has only limited research that indicates its absorption may be equal to calcium carbonate.

INSIDE

- Absorption • Effectiveness

The Search For Fact Vs Fiction: The Truth About Calcium

Calcium is one of the most important supplemental nutrients because of its role in bone health. The most common questions about calcium are which form of calcium absorbs best and which form is most bio-available to help maintain bone density. Confusing statements are sometimes made that bone cannot be rebuilt once it is lost. Usually this kind of statement is accompanied by marketing information that promotes one type of calcium, like calcium citrate, as absorbing best, while saying that it is also the “only” type of calcium that will rebuild bone. Is there any truth to these statements?

A thorough analysis of the scientific literature verifies that neither of these statements is correct. After investigating calcium in depth, SuperNutrition finds that only one form of calcium passes all our standards for use in our products. Calcium carbonate is the most natural, least processed form of calcium, the most potent per tablet, the least costly, and has been conclusively shown to build bone. Most other forms of calcium, like calcium citrate, are synthesized in laboratories, so added processing costs increase the net cost to you.

Ingredients We Use Must Pass Our Six Standards

We evaluate all ingredients that are included in SuperNutrition formulas based on six conservative criteria:

- 1) Is it natural and normal to the human body?
- 2) Has it had a long history of safe use in humans?
- 3) Is it supported by science and/or traditional herbal wisdom?
- 4) Is it nutritionally effective?
- 5) Is it cost-effective for our customers?
- 6) Is it concentrated enough that we can provide optimal levels to our customers in a reasonable number of tablets?

In this issue of *Fact Versus Fiction* we share key details that we have uncovered in the available scientific literature to show you the logical steps we took to determine the most cost efficient, most potent source of calcium that is proven to be effective. We also give you a look at the research that is available regarding **calcium citrate, which costs about 5 to 8 times more than calcium carbonate**. Naturally, because calcium citrate is a higher profit ingredient, there is more money available to spend promoting calcium citrate through advertising, marketing, articles placed in consumer magazines, and even to support university-level studies to assist marketing efforts to doctors. We further take brief looks at other exotic calcium products, such as “food-grown-type” calcium, that also delivers a higher profit than calcium carbonate, so it too has additional funding to support marketing campaigns.

This issue of Fact vs Fiction addresses several of the most common areas of confusion.

1. Does calcium carbonate absorb as well and is it as effective as other forms of calcium?

Studies that dispute this usually test fasting subjects or use an outdated testing method that was recently shown to be inaccurate. (See the Heaney study, page 2.) This *Fact Vs Fiction* investigates whether calcium carbonate, the most abundant natural form of calcium, is equal in absorption and effectiveness to other forms of calcium, like calcium citrate, calcium gluconate and “food-grown-type” calcium, which are all commercially synthesized using calcium carbonate as the original natural calcium source.

2. Does calcium from food absorb better than isolated forms of calcium, like calcium carbonate?

The surprise answer - No. Calcium from kale absorbs only marginally better than calcium carbonate.

3. What factors affect calcium absorption and utilization the most?

Stomach acidity? Solubility in water? Vitamin D? Taking calcium with food? The following studies may provide some surprises. As you read, keep in mind that perhaps the four most important considerations regarding calcium and its effect on bone are whether or not you take it with food in several divided doses throughout the day, your Vitamin D status, exercise, and the status of your body’s natural hormones.

4. How much calcium is required for bone maintenance for women? How much calcium is required for a healthy pregnancy?

Optimal dosing begins at approximately 1,000 mg for adult women. (See the studies on page 8 and 9.)

* “food-grown-type” is a commonly used term referring to nutrients that are fermented with yeast, soy, algae, citrus or other food. Note: **Bolds** and underlines are used in this publication to emphasize specific information.

Does Calcium Citrate, Which Costs Five To Eight Times More, Absorb Better Than Calcium Carbonate?

Sheikh MS, et al. Gastrointestinal absorption of calcium from milk and calcium salts. N Engl J Med (1987) Aug 27, 317(9): 532-536.

Comment: Articles on calcium frequently say that solubility (in water) greatly affects absorption. This precisely controlled peer-reviewed study with fasting young subjects challenges that idea by showing that the **absorption** of 500 mg of five different forms of calcium in *decreasing order of solubility* was 32% for calcium acetate (the most soluble form), 32% for calcium lactate, **27% for calcium gluconate, 30% for calcium citrate, and 39% for calcium carbonate (the least soluble form).**

The authors noted that although calcium carbonate absorption appeared to be somewhat superior, the differences in absorption were not considered to be *“statistically significant.”* “Statistical significance” is a specific scientific term that means that the study could not determine conclusively that there actually was any difference in absorption. This statement about a lack of “statistical significance” indicates that these forms of calcium probably don’t really absorb much differently and that we should only assign limited importance to the percentages given. Each form of calcium absorbed within the same basic range, approximately 30%.

While statements are sometimes made that calcium from food absorbs better than isolated forms of calcium like carbonate and citrate, this study stated that calcium absorption from milk, a food, was 31%, similar to the five isolated forms of calcium.

Additionally, while acidity has a role in absorption, in this study **calcium citrate, which is somewhat more acidic than calcium carbonate, dissolved less efficiently than calcium carbonate at a less acidic pH of 5, while at a normal highly acidic stomach pH of 2.5, there was no significant difference.**

This Landmark Study Discovered The Inaccuracy In The Older Testing Method That Has Made Calcium Citrate Appear To Be Superior

Heaney RP, et al., Absorption of calcium as the carbonate and citrate salts, with some observations on method. Osteoporos Int, 9(1):19-23 1999.

Comment: This seminal study of 37 adult men and women was performed by Dr. Robert Heaney, who has been involved in publishing over 500 calcium studies since 1962. It compared the two most common methods of testing calcium absorption: radioisotope testing, and the older test, called urinary increment testing. **Although both methods had been used in hundreds of studies over many years, no one had ever compared them to each other to see if one method was more accurate.**

Radioisotope testing was found to be three times more precise than the older urinary method.

Dr. Heaney analyzed several previous well-known studies that had found calcium citrate to be superior that used the urinary test and detailed how the urinary test *was not accurate enough* to provide a reliable estimate of calcium absorption.

Average absorption for both forms of calcium was found to be equal by radioisotope testing when taken with food at two different doses: **36% at 300 mg, and 28% at 1000 mg.**

Dr. Heaney said that *when taken with food, “calcium from carbonate is fully as absorbable as from citrate,”* and that the importance of the study’s meal context is that calcium carbonate absorption “can be erratic [for some subjects] when taken on an empty stomach.”

He concluded, “The inconsistency in past clinical methods for measuring calcium warranted a comparative reexamination, which we now have. It is time to consider the issue of calcium carbonate and absorbability settled.”

Future calcium absorption studies that are fully accepted by the scientific community and accepted for peer-review publication, will most probably use radioisotope testing, not urinary testing.

Two Studies That Stated That Calcium Citrate Absorbed Better On An Empty Stomach Also Stated That Absorption Is Equal When Taken With Food

Question: Why do so many magazine articles state that calcium citrate absorbs better than carbonate?

Answer: Unfortunately, magazine articles don't always provide a complete picture. For example, studies that show calcium citrate performs better almost always test empty stomachs. The study below by Recker also curiously compared calcium citrate in a liquid form to calcium carbonate as a powder in a gelatin capsule in people who have inadequate stomach acid production and don't digest gelatin optimally.

Harvey JA, et al. Superior calcium absorption from calcium citrate than calcium carbonate using external forearm counting. *J Am Coll Nutr* (1990) Dec;9(6):583-587.

Comment: Several studies have shown that calcium absorbs better with meals. This study looked at people with empty stomachs. Most studies where calcium citrate is shown to absorb better are conducted using people with empty stomachs. Scientists are still investigating whether calcium citrate absorbs better than calcium carbonate for some people while fasting. **Even with fasting subjects, average calcium citrate absorption on an empty stomach was 39% versus 31% for carbonate, not a great difference, although, in this study, it was a "significant" difference. That's only a difference of 8%.**

As in many other studies, the authors acknowledged that calcium citrate and carbonate absorbed equally when taken with food, so take your calcium supplement with food to enhance absorption.

Recker RR. Calcium absorption and achlorhydria. *N Engl J Med*, 313(2):70-3 1985 Jul 11.

Comment: Calcium carbonate absorption had been thought to be compromised in people who have achlorhydria (no stomach acid). This study was referred to in many popular health magazines in articles that stated that calcium citrate absorbs better than calcium carbonate. It compared absorption of 250 mg of calcium carbonate and calcium citrate in 11 fasting achlorhydric subjects (who have inadequate stomach acid production) and 9 fasting normally healthy subjects. The study measured the differences in absorption between calcium citrate in a liquid form and calcium carbonate as a powder enclosed in a gelatin capsule. The authors did not explain why they compared the two types of calcium this way.

When given to people who do not make stomach acid normally, calcium citrate ***that was dissolved in a liquid***, absorbed at 45.2%. When calcium carbonate ***as a powder enclosed in a gelatin capsule*** was also given to people who do not make stomach acid normally, absorption was 4.2%. **Gelatin capsules may not digest optimally when there is no stomach acid.**

Surprisingly, when calcium citrate in a liquid form was given to normally healthy fasting subjects who do make stomach acid, this study reported 24.3% absorption. When encapsulated calcium carbonate powder was given to normal fasting subjects who do make stomach acid, absorption was 22.5%, a difference of 1.8%.

Like the authors of the study above, the authors of this study acknowledged, "Calcium carbonate and citrate absorption was similar in both achlorhydric and normal subjects when taken with food."

Again, we see that scientists agree that calcium carbonate and calcium citrate absorb equally when taken with food, even when people do not have stomach acid. Now let's look at acidity and solubility and see how they may affect absorption. It has generally been assumed that because calcium citrate is slightly more acidic and somewhat more soluble in water than calcium carbonate, it absorbs better. However, numerous studies show that solubility and stomach acidity have little or no effect on absorption.

Surprise: Solubility In Water And Stomach Acidity Have Little Or No Affect On Absorption When Calcium Is Taken With Food

Heaney RP. Calcium supplements: practical considerations. *Osteoporos Int* (1991) Feb;1(2):65-71.

Comment: Dr. Heaney stated that taking calcium four times per day resulted in substantially greater absorption than taking it once per day. He also stated, ***"Differences in chemical solubility between supplement preparations are of little importance, with calcium carbonate, for example, being absorbed as well or better than some much more highly soluble [types of calcium]. Gastric acid is not necessary for absorption of even poorly soluble preparations, so long as they are taken with meals."*** He also noted, ***"Calcium intakes up to at least 2,500 mg are safe for virtually all patients."***

Heaney RP, et al. Absorbability of calcium sources: the limited role of solubility. *Calcif Tissue Int* (1990) May;46(5):300-304.

Comment: This study looked at seven types of calcium and found “*no effect of solubility on absorption.*” Without food, calcium carbonate absorbed at 23.5%, calcium citrate at 24.2%, while calcium hydroxyapatite, another useful form of calcium, absorbed at 16.6%. With food, calcium carbonate absorption increased to 29%, so taking calcium carbonate with food increased absorption 5.5%.

Note: 5.5% is a 23.4% increase over the absorption of calcium carbonate without food. (This study did not report absorption for the other forms of calcium when taken with food.)

Bo-Linn GW, et al., An evaluation of the importance of gastric acid secretion in the absorption of dietary calcium. *J Clin Invest*, 73(3):640-7 1984 Mar.

Comment: This study's authors began by saying, “*Since calcium solubility is a prerequisite to calcium absorption, and since solubility of calcium is highly acid-dependent, it has been generally assumed that gastric acid secretion and gastric acidity play an important role in the intestinal absorption of calcium from ingested food or calcium salts such as calcium carbonate.*” They found, however, that “*reduced gastric acid secretion had no effect on calcium absorption in normal subjects, and an achlorhydric patient with pernicious anemia absorbed calcium normally. This was true regardless of the calcium source, [Milk, calcium carbonate, or calcium citrate].*” Moreover, calcium absorption after taking calcium carbonate was almost the same both when the stomach was at a neutral pH of 7.4, or at a highly acidic pH of 3.0.

They concluded, “*Gastric acid secretion and acidity do not normally play a role in the absorption of dietary calcium,*” and “*there are other possible mechanisms by which the gastrointestinal tract might solubilize calcium [for absorption].*” This issue is still being investigated.

Taking Calcium With Food Improves Absorption Up To 30 Percent

Heaney, RP et al. Meal effects on calcium absorption. *Am J Clin Nutr*, 1989 Feb;49(2):372-376.

Comment: The effect of taking calcium with a meal or taking it on an empty stomach was investigated using calcium carbonate, milk calcium, or calcium citrate-malate. Six experiments with 168 rats and two studies with 456 normal young women showed that taking all three forms of calcium with a light meal enhanced absorption up to 30% greater than taking them without food.

Taking calcium with food can produce a much more powerful effect (up to 30%) than the differences in absorption seen between different types of calcium in various studies, between about 1 and 9 percent.

Note: Often the difference between absorption of calcium citrate and calcium carbonate has been expressed as the *percentage of difference* rather than the *actual percentage* because it makes the difference appear to be greater. Example: If calcium citrate is shown to absorb at 36% and calcium carbonate at 32%, this is a 4% difference in absorption. However, 4% is 12.5% of 32%, so it can also be stated as 12.5% better absorbed, which makes calcium citrate absorption appear to be much better than it actually is.

50 Percent: Is Vitamin D the Most Important Factor for Calcium Absorption?

Taking calcium with meals can improve calcium absorption up to 30%. Consider that Vitamin D may have an even more powerful effect on calcium absorption. About 50% of inadequate calcium absorption may be caused by inadequate Vitamin D.

Need AG, et al., Intestinal calcium absorption in men with spinal osteoporosis. *Clin Endocrinol (Oxf)*, 48(2):163-8 1998 Feb.

Comment: This study of men with osteoporosis and men with vertebral compression fractures found that men with fractures had less calcium absorption. The authors said, “*...about 50% of the deficit in calcium absorption ... is due to decreased [blood levels of] Vitamin D.*”

Vitamin D Also Helps To Reduce Calcium Loss from Bone Because Vitamin D Moderates Parathyroid Hormone

Optimal Vitamin D blood levels reduce parathyroid hormone secretion so that calcium is not leached from bone. With optimal Vitamin D, calcium absorption *AND* calcium retention in bone are optimized.

Krall EA, et al. Effect of Vitamin D intake on seasonal variations in parathyroid hormone secretion in postmenopausal women. N Engl J Med 1989 Dec 28;321(26):1777-1783.)

Comment: This study stated, *“Vitamin D intake should be sufficient to maintain calcium absorption and prevent increased parathyroid secretion throughout the year.”* Having adequate Vitamin D intake prevented a seasonal [wintertime] increase in parathyroid hormone secretion. This reduces calcium loss from bone.

Update: The RDA For Vitamin D May Not Be Enough - How Much Do We Need?

This seminal study summarized years of studies and asserted that the RDA for Vitamin D is too low and that *“in the absence of sunshine”* some people may require as much as 10,000 IU of Vitamin D per day.

Vieth R. Vitamin D supplementation, 25-hydroxyVitamin D concentrations, and safety. Am J Clin Nutr, 69(5):842-56 1999 May. Read the full text of the study at: <http://www.ajcn.org/cgi/content/full/69/5/842>

Comment: The authors said that for adults, *Vitamin D at 400 IU per day may not be enough* to prevent bone loss, especially in winter, when sun exposure is low and the body doesn't produce as much Vitamin D.

They also cited a 290-patient study that showed that even among people who took 400 IU of Vitamin D per day, deficiency occurred in 43% of the subjects. (See: N Engl J Med 1998;338(12):777-783).

They further emphasized that, *“Total body sun exposure easily [causes natural production] of the equivalent of 10,000 IU of Vitamin D per day ... To ensure that serum D concentrations are optimal, a total Vitamin D supply of 4,000 IU per day is required.”*

Except for those with hypersensitivity to Vitamin D, there is no evidence of adverse effects with [blood] Vitamin D concentrations that require a total Vitamin D supply of 10,000 IU per day.”

Vitamin D Toxicity With Hypercalcemia Has Not Occurred At Less Than 40,000 IU Per Day

Dr. Vieth also stated, *“Cases of Vitamin D toxicity with hypercalcemia, for which the Vitamin D dose is known, all involve intake of at least 40,000 IU per day. Since Vitamin D is potentially toxic at very high levels, daily intake greater than 1,000 IU has been avoided even though evidence shows that the currently accepted National Academy of Sciences’ “no observed adverse effect level” of 2,000 IU per day is too low by at least 5-fold.”* This means that Dr. Vieth believes that the *“no observed adverse effect level”* for Vitamin D should probably be 10,000 IU per day, which is 5 times 2,000 IU.

Can I Get Enough Vitamin D Walking To My Car?

Gannage-Yared MH, et al. Hypovitaminosis D in a sunny country: relation to lifestyle and bone markers. J Bone Mineral Research, September 2000, 15(9):1856.

Comment: This study showed that a few occasional minutes of sunlight with partial body exposure, such as we get walking to our car or between buildings, is probably not enough. **In this study, 83.9% of the women in sunny Lebanon who only get 100 IU of Vitamin D per day from their food had low blood Vitamin D.**

Women who wore veils had even greater risk of Vitamin D deficiency.

Suggestion: If you are experiencing bone loss, consult your doctor about increasing your daily Vitamin D intake, and show them this article. Ask them to give you the blood tests for Vitamin D, calcium, and parathyroid hormone. Your doctor may find that you need more Vitamin D than you are currently taking.

This Is Why SuperNutrition Is Raising The Vitamin D In Our Full Potency Formulas For Adults To 1,000 IU Per Day.

(Always ask your doctor before taking higher doses of Vitamin D, especially over 1,000 IU per day.)

Question: Where do the various forms of calcium come from?

Answer: With very few exceptions, **there are only two truly natural forms of calcium** in natural food stores. They are calcium hydroxyapatite (or bone meal, the denatured version of hydroxyapatite) from animal bones, and calcium carbonate, the most abundant form of calcium in nature, found in the earth and sea.

The reason that calcium carbonate is one of the least expensive forms of calcium is simply because it is close to being in its natural form, requiring little processing to produce it for use in dietary supplements.

Other popular forms of calcium that are sold in natural food stores, like citrate, gluconate, and “food-grown-type” calcium, are predominantly synthesized using calcium carbonate as the original natural calcium source. While synthesized molecules are sometimes misunderstood as not being natural, synthesis is simply a process for making something, in this case, making natural molecules, like calcium citrate, in a lab. However, they cost more because of the extra laboratory processing costs.

The higher costs provide additional money to fund marketing efforts, so we hear more about them in advertising and in the popular media.

The methods by which natural calcium carbonate and the synthesized forms of calcium are produced for commercial use are shown below as quoted from *Hawley's Condensed Chemical Dictionary*, 13th Edition, Editor: Richard J. Lewis, Sr. (Note: 1 is the most common method of production. 2 is the second most common method.)

Also noted are the cost of the type of calcium compared to calcium carbonate and the number of tablets that are required to provide 1,000 mg. Different forms of calcium have different densities, so the net amount of elemental calcium provided by an equal weight of one form of calcium can be very different from the amount of elemental calcium provided by another.

The net amount of elemental calcium intake was the single most important factor for preserving bone density in the Storm study of senior women on page 8, which showed that “at least 1,000 mg of [elemental calcium from] calcium carbonate plus [683 mg of calcium from] diet per day was enough.”

Calcium carbonate: Least expensive. 1,000 mg = 2 medium sized (approximately 1,350 mg) tablets.
Produced by: 1. Mined from natural surface deposits. 2. Precipitated by reaction of calcium chloride and sodium carbonate in water solution or by passing carbon dioxide through a suspension of hydrated lime in water.

Calcium citrate: Cost: 5 to 8 times more than calcium carbonate. 1,000 mg = 4 medium sized tablets.
Produced by: Calcium carbonate is burned in a kiln, which releases carbon dioxide to produce calcium oxide. A moldy fermentation is done on carbohydrate materials, which produces citric acid. Then citric acid is bonded to calcium oxide to synthesize calcium citrate.

Calcium gluconate: Cost: 9 times more than calcium carbonate. 1,000 mg = 9 medium sized tablets.
Produced by: Neutralization of gluconic acid with lime or calcium carbonate.

Calcium chloride: Cost: 3 times more than calcium carbonate. 1,000 mg = 2 medium sized tablets.
Produced by: 1. Calcium chloride is produced by the action of hydrochloric acid on calcium carbonate and subsequent crystallization. 2. Commercially obtained as a by-product in the Solvay soda and other processes.

“Food-grown-type” calcium: Cost: 12 times more than calcium carbonate. 1,000 mg = 16 medium sized tablets.

Produced by: Calcium chloride (which is primarily synthesized from calcium carbonate, as above), and “water, starch and protein” are combined with a “live yeast mixture,” according to: *Vinson J, et al. Comparison of different forms of calcium on blood pressure of normotensive young males. Nutri Rep Int Sept 1987;36(3):498.*

Calcium Lactate: Cost: 4 times more than calcium carbonate. 1,000 mg = 4 medium sized tablets.
Produced by: 1. Ferment starch, milk whey, molasses, potatoes, and neutralize the acid when formed with calcium carbonate. The lactate solution is concentrated and decomposed with sulfuric acid. 2. Synthesized by hydrolysis of lactonitrile.

Comment: Calcium carbonate, a form of calcium that is closest to nature, costs significantly less than other forms of calcium and requires fewer tablets to provide 1,000 mg of elemental calcium.

Does Calcium Carbonate Absorb As Well As Calcium From Food?

Surprise answer: Yes. Several studies verify that calcium carbonate (and calcium citrate) absorb approximately equally to calcium found in food.

The following studies showed that spinach calcium absorption is lower, while **calcium from kale absorbs at 40.9%** (the top of the absorption range for the limited number of foods measured for calcium absorption). **Two of the studies at the beginning of this paper showed calcium carbonate and citrate absorbing at 39%, so calcium from kale absorbed only marginally better.**

Heaney RP, et al., Calcium absorbability from spinach. Am J Clin Nutr, 47(4):707-9 1988 Apr.

Milk calcium absorbed at 27.6%; spinach at 5.1%, because oxalates in spinach inhibit calcium absorption.

Hansen M, et al., Calcium absorption from small soft-boned fish. J Trace Elem Med Biol, 12(3):148-54 1998 Nov.

Calcium absorption from sardines absorbed comparably to calcium from milk, about 23%.

Note: The difference in milk absorption in the above two studies and the Sheikh study on page 2 (27.6%, 23% and 31%) demonstrate that different studies may show variations in the absorption of the same food, a problem with studies in general. That is why it is best to assume that study results are approximate averages, rather than precise calculations (down to the decimal point).

Heaney RP, et al., Calcium absorption from kale. Am J Clin Nutr, 51(4):656-7 1990 Apr

Calcium from kale, a dark green leafy vegetable, absorbed at 40.9%, and calcium from milk at 32.1%.

Calcium from kale, a “best” absorbing vegetable calcium source, absorbed only slightly better than calcium carbonate (40.9% versus 39% = 1.9%). While “food-grown-type” calcium is claimed to absorb at 80% or more, how could it absorb better than kale?

Does Calcium Carbonate Absorb As Well As “Food-Grown-Type” Calcium?

The food-yeast-calcium combination, commonly known as “food-grown-type” calcium, is sometimes thought to absorb better than calcium carbonate because it is marketed as being “food” or “whole food,” so people think that the calcium is extracted from foods, like broccoli, or kale. These are misunderstandings, as the details on page 6 showed that “food-grown-type” calcium is synthesized in a laboratory process designed by humans that uses USP-type calcium carbonate. It is not harvested directly from the Earth or produced by Mother Nature.

Although we could find no published studies that directly compare “food-grown-type” calcium with calcium carbonate, we did find a study, which was funded by the manufacturer, shown below, that compared “food-grown-type” calcium with calcium gluconate.

Vinson JA, et al. Comparison of different forms of calcium on blood pressure of normotensive young males. Nutri Rep Int Sept 1987;36(3):497-501.

While claims are made that “food-grown-type” calcium absorbs many times better than USP-type calcium sources, **the summary of this manufacturer-funded study stated**, “*The present study indicates that [“food-grown-type” calcium] was more absorbed than the [USP-type] calcium gluconate, but the difference was not quite significant due to the small number of subjects.*”

“*Not quite significant*” is a specific scientific term that means that the study could not determine conclusively that there actually was any difference in absorption.

The New England Journal of Medicine study by Sheikh on page 2 showed that calcium carbonate was also somewhat better absorbed (at 39%) than calcium gluconate (at 27%), but the difference was also *not considered to be statistically significant*.

This indicates that there is probably *no significant difference in absorption* between “food-grown-type” calcium and calcium carbonate, because of their common relationship with calcium gluconate.

Note: While numerous studies show improved bone density with calcium carbonate (and calcium citrate), no published studies show that “food-grown-type” calcium improves bone density in humans.

Question: I've heard that "food-grown-type" calcium absorbs 8.79 times better than calcium carbonate and 2.79 times better than calcium gluconate. Is this true?

Answer: This is not possible. Calcium carbonate has been shown to absorb at approximately 23% to 39% in numerous studies. If this were true, "food-grown-type" calcium would have to absorb at a rate over 100%, actually 202% to 340%. Absorption cannot be more than 100%. Also, the numbers 8.79 and 2.79 are questionable since calcium carbonate and calcium gluconate have been shown to absorb without significant differences in peer-reviewed published studies (See Sheikh study, p.2).

Comment: Taking calcium with meals improves absorption up to 30%, but meals provide about 500,000 mg of food. Compare this to the typical 1,000 mg of food in a tablet. **Tablet amounts of food (1,000 mg) cannot affect absorption as much as the amount of food in a meal (500,000 mg).**

Important point: Green leafy vegetables, like kale, supply excellent natural calcium, and numerous other nutrients, like Vitamin K and boron, which are critical for bone health. Besides taking a calcium supplement, one of the most important things you can do for long-term bone health is to eat dark green leafy vegetables.

The studies below suggest that calcium supplementation should begin at about 1,000 mg per day.

Calcium Carbonate Reduces Pre-Menstrual Syndrome In A Double-Blind, Placebo-Controlled Multi-Center Study of 466 Women

Thys-Jacobs S, et al. Calcium carbonate and the premenstrual syndrome: effects on premenstrual and menstrual symptoms. Am J Obstet Gynecol, 179(2):444-52 1998.

Comment: 466 healthy pre-menopausal women between ages 18 and 45 who had 17 moderate-to-severe premenstrual symptoms and 4 symptom factors (water retention, food cravings, negative effect, and pain) were given 1,200 mg of daily calcium carbonate or placebo for 3 menstrual cycles. During the luteal cycle phase, **symptoms were significantly reduced in the calcium carbonate group** for both the 2nd and 3rd menstrual cycles. *By the 3rd menstrual cycle calcium effectively resulted in a statistically significant 18% better reduction in total symptom scores compared with placebo.* All 4 symptom factors were also significantly reduced. The authors said, **"Calcium supplementation is a simple, effective treatment in premenstrual syndrome, resulting in a major reduction in overall luteal phase [PMS] symptoms."**

Calcium Carbonate Effectively Stops Bone Loss And Increases Bone Density

Storm D, et al. Calcium supplementation prevents seasonal bone loss and changes in biochemical markers of bone turnover in elderly New England women: a randomized placebo-controlled trial. Clin Endocrinol Metab, 83(11):3817-25 1998 Nov.

Comment: Studies show that women who reside in northern latitudes experience the most pronounced bone loss during winter, when their body's Vitamin D production is low, **especially when they consume less than 1,000 mg of calcium per day.** This study tested the hypothesis that calcium supplementation by either calcium carbonate or calcium from milk could prevent seasonal bone loss and preserve bone mass.

Sixty older postmenopausal women with no osteoporosis were divided into 3 groups:

Placebo – their intake consisted only of the calcium found in their *normal diet*: **683 mg average per day.**

Normal diet plus 4 glasses of milk per day: **1028 mg of calcium from their diet with milk calcium.**

Normal diet plus 1000 mg of calcium carbonate in two divided doses: **1683 mg of calcium total per day.**

After 2 years:

The placebo group (683 mg of daily dietary calcium) **lost 3.0% of their greater bone mineral density.**

The group with a normal diet plus milk (1,028 mg of daily calcium) **lost 1.5% of their greater bone mineral density. (Higher calcium intake resulted in less bone loss than diet alone.)**

Those who received their normal diet plus 1,000 mg of calcium carbonate, (1,683 mg total daily calcium), **"suffered no bone loss and gained a significant increase in spinal (3.7%) and hip (3%) bone mineral density."** Hipbone density with calcium carbonate was 4.8% better than with diet alone.

The authors said, "Total calcium intake was the strongest predictor of hip bone loss."

They concluded, **"Calcium carbonate supplementation prevents bone loss in elderly women by suppressing bone turnover during winter when [blood] Vitamin D declines and parathyroid hormone**

increases.” The authors also said, “*The precise amount of calcium necessary to preserve [bone density] in elderly women requires further studies, although in this study, at least 1,000 mg of [supplemental] calcium carbonate plus [683 mg of calcium from] diet per day was enough. However, total food and supplemental calcium greater than 1,000 mg appear to be necessary for optimal bone health in elderly women.*”

Important note: This study showed a clearly defined dose-dependent effect on bone loss and bone gain.

They lost 3% bone when they consumed 683 mg of calcium from food
They lost 1.5% bone when they consumed 1,028 mg of calcium from food with milk.
They gained 3.7% in spine bone density and 3% in hipbone density when they consumed 1,683 mg of calcium per day from a combination of food and calcium carbonate.

Is Calcium Carbonate Supplementation Effective And Safe During Pregnancy?

Koo WW, et al. Maternal calcium supplementation and fetal bone mineralization. *Obstet Gynecol* 1999 Oct;94(4):577-582. wkoo@wayne.edu

Comment: This **double-blind study** of 256 prenatal women looked at the effect of calcium carbonate intake on their baby’s bones. Women who got less than 600 mg of daily dietary calcium and took between about 1,200 mg and 2,000 mg of calcium carbonate per day during the 2nd and 3rd trimesters had babies with about 15% better bone density.

The study said, “*Maternal calcium intake of up to 2,000 mg per day during the 2nd and 3rd trimesters can increase [baby’s] bone mineralization in women with low dietary calcium.* In an interview, the author stated, “*Low calcium intake during pregnancy can soften baby’s bones and women who have an aversion to high calcium foods should consider supplements.*”

The study noted there was “*no excess bone mineral retention*” for babies, even when “*calcium [carbonate] intake exceeded 3,000 mg per day from mid-pregnancy until [birth].*”

Calcium carbonate supplementation is safe and effective for prenatal mothers and their babies.

Exercise Improve Calcium Absorption Up To 8 Percent

Lutz J, et al Hypokinesia-induced negative net calcium balance reversed by weight-bearing exercise. *Aviat Space Environ Med* 1987 Apr;58(4):308-314.

Comment: This study stated that calcium absorption is reduced during immobilization when bone loss increases, and showed that calcium absorption increased as much as 8% during periods of exercise, including running.

Does Calcium Carbonate Cause Constipation?

Answer: The only available study says calcium carbonate did not cause constipation in healthy people.

Saunders D; Sillery J; Chapman R. Effect of calcium carbonate and aluminum hydroxide on human intestinal function. *Dig Dis Sci*, 33(4):409-13 1988 Apr

Comment: This three-week study investigated the effects of 6,000 mg of calcium carbonate per day on human gastrointestinal function. The authors said, “*Carbonate is reputed to have an effect on reducing fecal fat, an undocumented association with constipation and a reputed ability to reduce cancerous effects of bile acids and fatty acids on colon tissue.*”

They found that calcium carbonate did not alter the intestinal transit time of the eight subjects. In fact, it slightly increased daily output of feces by 24%, and increased output of fecal fats by 213%, and bile acids by 87%.

The researchers said, “*These observations help to explain how [calcium carbonate] may lower blood lipids and ameliorate the effects of fecal bile acids and fatty acids on [colon tissue].*”

Note: Excess fecal fatty acids and bile acids are associated with colon tissue inflammation, so calcium carbonate supplementation might contribute to optimal colon tissue health by reducing these acids.

Does Calcium Carbonate Or Too Much Calcium Cause Kidney Stones?

Until 1983 it was commonly assumed that higher calcium intake could increase kidney stone formation.

The following landmark study of 45,619 men corrected this misunderstanding by showing that **men who were deficient in calcium had more calcium (oxalate) stone formation in their kidneys. It also showed that higher calcium intake reduced stones.** This appears to happen because calcium can help to reduce oxalic acid absorption in the intestine by binding with oxalic acid and carrying it out of the body in the feces, so less oxalate stones form in the kidneys. Roughly 99% of kidney stones are composed of calcium oxalate.

Curhan GC, et al. A prospective study of dietary calcium and other nutrients and the risk of symptomatic kidney stones. *N Engl J Med* 1993 Mar 25;328(12):833-838.

Comment: This study said, “A high dietary calcium intake is strongly suspected of increasing the risk of kidney stones. However, a high intake of calcium can reduce the urinary excretion of oxalate, which is thought to lower the risk. Less urinary excretion indicates inhibition of oxalate absorption into the body. Dietary calcium intake was inversely associated with the risk of kidney stones.”

Men who consumed the most calcium had the least potential for kidney stones. Higher dietary potassium intake and increased fluid intake were also associated with having a lower incidence of stones.

Levine RJ, et al. Trial of calcium in preeclampsia. *N Eng J Med* 1997;337:69-76.

Comment: This study showed no increase in kidney stones among 2295 women who took 2,000 mg of calcium carbonate per day for a study period of up to 25 weeks.

Takei K, et al. Oral calcium supplement decreases urinary oxalate excretion in patients with enteric hyperoxaluria. *Urol Int* 1998;61:192-195.

Comment: This study investigated four different types of calcium supplements and said that appropriately dosed oral calcium supplementation may be “...an effective strategy [to reduce kidney stones]...”

Curhan GC, et al. Comparison of dietary calcium with supplemental calcium and other nutrients as factors affecting kidney stones in women. [Letter] *Ann In Med* 1997;127(9):846.

Comment: Two authors, including Dr. Robert Heaney, hypothesized that taking calcium carbonate with food might decrease the risk of kidney stones because calcium binds with oxalic acid in the intestine and carries it out of the body, which reduces the potential for calcium oxalate kidney stone formation in the body.

Williams CP, et al. Why oral calcium supplements may reduce renal stone disease: report of a clinical pilot study. *J Clin Pathol* 2001;54:54-62.

Comment: 500 mg of daily calcium carbonate improved mechanisms associated with reduced kidney stones.

However, this is still being investigated, and no one has reached a solid conclusion about whether calcium carbonate (or other forms of calcium) supplementation can reduce the incidence of kidney stones.

Side Note: Higher Doses of Vitamin C Have Been Shown To Decrease Kidney Stones And Increase Bone Density

Gerster, H. No contribution of ascorbic acid to renal calcium oxalate stones. *Ann Nutr Metab* 1997;41(5):269-282

Comment: For those who are concerned that Vitamin C intake might increase the risk of kidney stones, this study stated that, “In the large-scale Harvard Prospective Health Professional Follow-Up Study, **those groups in the highest quintile of Vitamin C intake, above 1,500 mg per day, had a lower risk of kidney stones than the groups in the lowest quintiles.**”

Morton DJ, et al. Vitamin C supplement use and bone mineral density in postmenopausal women. *J Bone Min Res* 2001;16(1):135-140.

Comment: This study showed that senior women who took between **1,000 and 5,000 mg of supplemental Vitamin C** per day had approximately **5% greater spinal bone mineral density** than women who took 500 mg or less over three years. **Higher Vitamin C doses were superior to 500 mg per day or less.**

Why Don't Women in Argentina With Low Calcium Diets Get Osteoporosis?

Question: Why don't Argentine women who only get 300 mg of daily calcium from their diet suffer from osteoporosis, while American women, who may take 1,000 mg calcium supplements, get osteoporosis? Does this prove that getting 1,000 mg of calcium per day can cause bone loss?

Answer: The Storm study on page 8 shows that American women who take 1,000 mg of calcium per day have increased bone density. However, there are two reasons that women in Argentina or Third World countries are hard to compare to Americans. **a. They generally perform more weight-bearing labor in the sun.** Weight-bearing labor stimulates bone growth. **Americans are more sedentary, and may not get enough weight-bearing exercise to stimulate bone growth.** **b.** Regular sunlight exposure stimulates optimal production of the body's Vitamin D, up to 10,000 IU per day. (See the Vieth study on page 5.) Higher Vitamin D blood levels provide two benefits:

1. It reduces the potential for poor calcium absorption by as much as 50 percent. (See the study by Need on page 4). A 50 percent difference significantly enhances calcium's effects on bone.
2. Optimal blood levels of Vitamin D reduce parathyroid hormone blood levels, so that calcium is not leached from bone. **Hard-working Argentine women who gets lots of sun do not lose bone as easily.** American women who do not get significant daily sun exposure have been shown to lose a considerable amount of bone **when calcium intake is low**, especially in winter, when parathyroid hormone secretion increases. The study by Storm on page 8 demonstrated this conclusively.

There is little similarity between women in Argentina or Third World countries who get daily sunlight and weight-bearing labor and sedentary Americans who do not get enough exposure to sunlight or intense physical activity. (See: Spindler A, et al. Bone mineral density in a native population of Argentina with low calcium intake. J Rheumatol 1995 Nov;22(11):2148-2151.)

Do Women In China Get Osteoporosis?

Question: I've heard that women in China do not get osteoporosis, even though they eat a low calcium diet. I've heard that there is not even a word for osteoporosis in the Chinese language. Are these true? American women often take 1,000 mg calcium supplements, but don't they suffer bone loss? Doesn't this prove that getting 1,000 mg of calcium per day can cause bone loss?

Answer: Again, the Storm study showed that 1,000 mg of calcium per day builds bone density. **No matter where they live, women experience the bone loss disease called osteoporosis if they are sedentary, or do not get enough calcium, weight-bearing activity or moderate, regular sunlight.**

Chinese scientist Dr. Kung investigated calcium in Chinese women in "*Age-related osteoporosis in Chinese: an evaluation of the response of intestinal calcium absorption and calcitropic hormones to dietary calcium deprivation.*" (Kung AWC, et al. Am J Clin Nutr 1998;68:1291-1297.)

Analysis of Kung's study by Dr. Robert Heaney showed that **Chinese women actually average up to 10% more calcium intake than American women when adjusted for their smaller body size.** However, this is still generally not enough calcium to protect their bones, so they have the same problem with bone loss as American women who do not get adequate calcium intake. (See: Heaney RP. Age-related osteoporosis in Chinese women. Am J Clin Nutri 1999;69(6):1291-1292.)

Published studies show that the rates of osteoporosis between American women and Chinese women are quite similar for women who have similar characteristics. Sedentary women with low calcium intakes and not enough exercise and regular, moderate exposure to sunlight experience osteoporosis at similar rates, whether they live in the United States or China.

It is true that there is no single word in the Chinese language that means "osteoporosis." This is because the Chinese language is based on characters. There are 10 Chinese characters that refer to "osteoporosis" that roughly mean, "*This kind of disease causes the bone to lose.*" To translate English to Chinese go to Babelfish at: <http://babelfish.altavista.com/tr>.

There are numerous studies that have investigated osteoporosis in Chinese women since 1961 that are available on Medline. Apparently, Chinese women do get osteoporosis.

New Data Show That Seniors May Need Higher Calcium Doses

Heaney RP. Calcium needs of the elderly to reduce fracture risk. J Am Coll Nutr 2001 Apr;20(2 Suppl):192S-197S.

Comment: In this study, Dr. Heaney pointed out that the typical 600 mg per day dietary calcium intakes of people living in contemporary industrialized nations are "...substantially lower than [calcium intake] that human physiology is adapted to by evolution." **Evolutionary studies by Eaton and Conner have indicated that humans are adapted by evolutionary need to get approximately 1,600 to 2,100 mg of calcium per day from food to stay healthy.** (See: Eaton, et al. N Engl J Med 1985 Jan 31;312(5):283-289.)

Dr. Heaney stated that inadequate calcium intake has caused "high bone turnover" to occur with high levels of parathyroid activity, as "increasingly the body tears down bone to access its calcium."

As a result, "the calcium requirement for skeletal maintenance is said to rise with age." Dr. Heaney further says that, "**Supplemented intakes of 1300 to 1700 mg per day have been shown to arrest age-related bone loss and to reduce fracture risk in people 65 and older.**" He also said, "**Supplemental [calcium] intakes of 2400 mg per day can restore the setting of the parathyroid glands to young adult values.**"

Improved parathyroid function to "young adult values" can reduce the loss of calcium from bone and bone loss, which reduces the rate of fractures and other health problems over the long term.

Conclusions and Suggestions:

1. Calcium carbonate absorbs as well as calcium citrate *when taken with food.*
2. Taking calcium with meals (in several divided doses) throughout the day improves absorption as much as 30%.
3. Get adequate daily Vitamin D supplementation, especially if you don't get regular, moderate exposure to sunlight. Vitamin D supplementation improves calcium absorption and moderates parathyroid hormone function, thus reducing calcium loss from bone.
4. The 400 IU RDA for Vitamin D is probably not enough for many people. SuperNutrition is raising the Vitamin D doses in our multi-vitamins to 1,000 IU per day for this reason. The National Academy of Sciences' 2,000 IU safe upper limit may be too low for some people. Ask your doctor to test your blood level of Vitamin D and your parathyroid hormone level to determine if you need more Vitamin D.
5. If possible, get some regular, moderate daily exposure to sunlight, to enable sunlight to promote conversion of pro-vitamin D in your skin into Vitamin D. (Because of genetic adaptation, light skinned people require considerably less sunlight than darker skinned people to produce adequate Vitamin D. Darker skinned people, who do not get much sunlight, are more likely to be deficient in Vitamin D.)
6. Because calcium carbonate is one of the densest forms of calcium at 40 percent elemental calcium, calcium carbonate requires fewer tablets than other forms of calcium.
7. Calcium carbonate is close to being in its natural form, so it is also one of the most economical forms of calcium. The less laboratory processing or synthesizing steps there are, the lower the cost will be.
8. Make sure you get at least the U.S. Government's recommended daily allowance of calcium: 1,300 mg for children, ages 9-18; 1,000 mg, from ages 19-50; and 1,200 mg over 50 years of age. Lesser amounts have been shown to increase the potential for bone loss. See the Storm study on page 8.
9. Seniors should consider that they might need calcium doses of 1,300 mg to 2,400 mg per day. On page 3, Dr. Robert Heaney said, "*Calcium Intakes up to at least 2,500 per day are "safe for virtually all patients."* Ask your doctor about taking higher calcium doses, and show them this document.
10. Prenatal women should consider taking 1,200 mg or more of calcium per day to ensure healthy baby's bones. Ask your doctor to assist you in finding an appropriate daily calcium dose.
11. Participate in weight-bearing or resistance exercise, like lifting weights, walking, running or swimming. Weight-bearing exercise, especially lifting weights, improves calcium absorption and bone density.
12. Eat dark green leafy vegetables, an excellent source of calcium and other bone-building nutrients.

Evaluation of Three Forms of Calcium For SuperNutrition Products

Is the form of calcium as carbonate, citrate or “food-grown-type” calcium acceptable for our supplements? We rate these forms of calcium in six evaluation categories as acceptable, partly acceptable, questionable, or not acceptable.	<u>Score</u>	<u>Score</u>	<u>Score</u>
	<u>Carbonate</u>	<u>Citrate</u>	<u>Food-grown-type</u>
<p>1. Is it natural to the human body? Calcium carbonate is natural to the human body. Calcium citrate is natural to the human body. “Food-grown-type” calcium is natural to the human body.</p>	Acceptable	Acceptable	Acceptable
<p>2. Has it had a long history of safe use in humans? Calcium carbonate has been used safely in dietary supplements for over 80 years. Calcium citrate has been used safely in dietary supplements for over 40 years. “Food-grown-type” calcium has been used in dietary supplements for over 18 years, but contains yeast, so it may cause yeast allergies.</p>	Acceptable	Acceptable	Not Acceptable
<p>3. Is it supported by science and/or traditional herbal wisdom? Calcium carbonate has been studied extensively. Calcium citrate has been studied extensively. “Food-grown-type” calcium has only a few studies conducted by one paid researcher. Claims for absorption and bioavailability have not been supported by independent research.</p>	Acceptable	Acceptable	Questionable
<p>4. Is it nutritionally effective? Studies have shown that calcium carbonate builds bone. Studies have shown that calcium citrate builds bone. No studies have confirmed “food-grown-type” calcium builds bone.</p>	Acceptable	Acceptable	Questionable
<p>5. Is it cost effective? Calcium carbonate is the least expensive, most cost effective form of supplemental calcium. Calcium citrate is 5 to 8 times more expensive than calcium carbonate. “Food-grown-type” calcium costs 12 times more than calcium carbonate.</p>	Acceptable	Not Acceptable	Not Acceptable
<p>6. Is it in a concentrated enough form that we are able to give optimal levels in a reasonable amount of tablets? Calcium carbonate is the most concentrated form of calcium. Calcium citrate requires twice as many tablets as calcium carbonate. “Food-grown-type” calcium requires eight times as many tablets as calcium carbonate.</p>	Acceptable	Partly Acceptable	Not Acceptable
<p>We find that calcium carbonate is acceptable in every evaluation category. We find that calcium citrate has limited usefulness because of the greater cost and number of tablets required, so we only use very small amounts. We find that “food-grown-type” calcium is unacceptable because of a lack of independent research and because of the much greater cost and number of tablets required.</p>	Acceptable	Partly Acceptable	Not Acceptable

Available Fact Versus Fiction Reports

1. Fact vs Fiction: Copper Sulfate
- 2b. Fact vs Fiction: Calcium Carbonate,
Calcium Citrate, and “Food-Grown-Type” Calcium
3. Fact vs Fiction: Saw Palmetto
4. Fact vs Fiction: “Food-grown-type” nutrients
Versus USP-Type nutrients
5. Fact vs Fiction: Vitamin Safety Doses

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