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The High Bioavailability Of Calcium Carbonate: Comparisons With Other Calcium Compounds

Calcium Carbonate: A Calcium Source Of High Bioavailability

There have been many studies conducted and papers written about the relative bioavailabilities of calcium from milk and from the various calcium salts that can be used in fortified foods and nutritional supplements. Some papers tout one particular calcium salt as vastly superior to all others.

Most studies find that:

- (1) *calcium is essentially equally absorbed from the types of calcium sources now commonly used; and*
- (2) *bioavailability is not related to water solubility.*

Here are summaries of some of those studies:

From the Institute of Medicine of the U.S. National Academy of Science:

Dietary Reference intakes for calcium, phosphorus, magnesium, vitamin D, and fluoride, Institute of Medicine, National Academy Press, Washington, D.C., 1997, p. 71.

A comprehensive review of the literature was done as part of the development of the revised Dietary Reference Intakes for calcium. This is what the Food Nutrition Board concluded:

"Bioavailability of calcium when measured from nonfood sources, or supplements, depends on the presence or absence of a meal and the size of the dose. Supplement solubility is not very important, but tablet disintegration (for example, breaking apart) is essential."

"In studies that measured calcium absorption under similar test conditions, a 250 mg (6.2 mmol) elemental calcium load given with a standardized breakfast meal resulted in average fractional absorption rates of calcium from calcium citrate malate, calcium carbonate, and tricalcium phosphate of 35, 27, and 25 percent, respectively. ... Under the same conditions, absorption of calcium from milk was similar at 29 percent."

Bioavailability of Calcium in Breads Fortified with Different Calcium Sources:

Ranhotra, G.S., et. al., Cereal Chemistry, 74(4):361-363.

"In breads fortified with five different Ca sources, Ca was equally well available from all sources, as judged based on Ca status of the femur in experimental animals and Ca absorption data. Ca carbonate, a commonly used Ca source in fortified foods and in Ca supplements, was one of the sources tested. This Ca source can be viewed as good a source of bioavailable Ca as the more expensive sources."

"RB (Relative Bioavailability) of Ca in Ca carbonate was arbitrarily set at 100%, and other sources were compared to this. Such a comparison revealed that RB of Ca in other sources was no higher than that of Ca in Ca carbonate. (Table III)."

TABLE III					
Relative Bioavailability Of Calcium In Sources Tested					
Percent Relative Bioavailability ^a					
Parameter	Carbonate	Sulfate	Citrate	Lactate	Suppl. ^b
Total Femur Ca	100	100	100	102	103
Percent Femur Ca	100	111	106	101	101
Calcium Absorption	100	103	104	104	102
Average	100	105	103	102	102

^a As compared to Ca in Ca carbonate (=100%)
^b Supplement contained Ca gluconate, Ca lactate and Ca carbonate."

Comparison of 3 Calcium Salts In College Women Using Isotopes:

Martin, B.R., et al, FASEB (Federation of American Societies for Experimental Biology) Journal, 2 No. 4 (1988), paper 2076.

"Average calcium fractional absorption from calcium lactate (35.2% ± 3.6), calcium carbonate (31.9% ± 5.9) and calcium sulfate (31.6% ± 5.4) was not significantly different in healthy college women."

Calcium Carbonate Compared to Calcium Lactates and Oyster Shells:

Tsugawa, N., et. al., Biol Pharm Bull, 18 No. 5 (May,1995), 677-682.

"We conclude that calcium is utilized to the same extent from calcium carbonate, DL-calcium lactate, L-calcium lactate and powdered oyster shell-calcium."

Solubility and Absorbability of Calcium Salts:

Weaver, Connie M., International Dairy Journal, 8 (1998), 443-449.

"When a variety of salts with a wide range of solubility in water at neutral pH were compared, only salts outside the range 0.1-10mM [millimoles/liter] in solubility exhibited a detectable difference in calcium absorption. (Table 2)."

Table 2		
Solubility and Absorbability of Calcium Salts		
Source	Solubility (mM/L)	Fractional absorption
Calcium oxalate	0.04	0.102 ± 0.040
Calcium carbonate	0.14	0.296 ± 0.054
Tricalcium phosphate	0.97	0.252 ± 0.130
Calcium citrate	7.3	0.242 ± 0.049
Calcium citrate malate	80	0.363 ± 0.076
Bisglycincalcium	1500	0.440 ± 0.104

Bioavailability of Calcium from Four Sources:

Garcia-Lopez, S. and G.D. Miller, Nutrition Research, 11 No. 10 (1991), 1187-1196.

"The bioavailability of Ca from calcium carbonate, calcium citrate, tricalcium phosphate and reduced particle size calcium citrate was estimated in Sprague-Dawley rats... The results indicate that, in the rat, there is no significant difference in Ca bioavailability from the 4 sources tested."

A Comparison of Several Calcium Supplements:

Kohls, K.J. and C. Kies, Journal of Applied Nutrition, 44 No. 3/4 (1992), 50-61.

"The additional Ca sources used were milk, oyster shell, dolomite, calcium carbonate, ... calcium gluconate and calcium lactate ... Pronounced differences in apparent absorption of Ca supplements for the intestinal tract were not demonstrated."

Calcium Absorbability from Calcium Carbonate and Milk Products:

Recker, R.R., et. al., American Journal of Clinical Nutrition, 47 No. 1 (1988), 93-95.

"Whole milk, chocolate milk, yogurt, imitation milk (prepared from dairy and nondairy products), cheese and calcium carbonate were...administered as a series of test meals...None of the sources was significantly superior or inferior to the others."

Conclusions:

- *There is little or no significant difference in the bioavailabilities of most of the calcium compounds available for the fortification of food and the manufacture of nutritional supplements.*
- *So for most applications there is no need to use an expensive calcium source.*
- *Calcium carbonate should be the calcium salt of choice.*
 - *It is high in elemental calcium - 40% - meaning less is needed to give the desired level of calcium.*
 - *It is low in price.*
 - *This combination makes it by far the most economical in use.*

Specialty Minerals Inc.
35 Highland Avenue
Bethlehem, PA 18017

For order placement:
Customer Service – toll free: 877-684-7627
Direct dial: 610-997-8306
Fax: 610-861-5179

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