

# Reducing Osteoporosis

*The role of calcium and soy isoflavones in osteoporosis prevention.*

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**C**alcium and soy isoflavones are two essential ingredients on top of the list for women's health. Calcium is the most important bone builder mineral used in the prevention and treatment of osteoporosis, while soy isoflavones are a natural remedy to HRT, which relate to menopausal women. According to *Nutritional Business Journal*<sup>1</sup>, calcium is by far the leading ingredient for osteoporosis prevention and treatment, representing 87% of bone health products sales. According to another report (NBJ, May 2002), soy supplements are the best-selling supplements that are aimed at women, particularly to treat menopausal symptoms. Sales of soy isoflavones grew by 112% from 1999 and are expected to increase further still due to the growing awareness of their benefits for bone and cardiovascular health, backed by clinical trial results<sup>2</sup>.

## Osteoporosis – Risk Factors and Occurrence

Osteoporosis, a serious bone loss disease, which occurs in women and men of all races, is a progressive disease without symptoms or warning signs until the disease is advanced. Osteoporosis is also known as the 'silent epidemic'.

Women are at greater risk of developing osteoporosis after menopause, when the ovaries produce less estrogen. Since estrogen is important for maintaining bone strength, the lack of it can cause the loss of calcium from the skeleton.

Other factors that increase the risk of developing osteoporosis are: smoking, alcohol, lack of exercise, low body weight, heredity, low daily intake of calcium in the diet or lactose intolerance.

Osteoporosis-related fractures are lower in Asia than in most Western communities, possibly due to the isoflavone-rich soybeans consumed in large quantities in the Asian diet. Ho et al<sup>3</sup> investigated the rates of hip fracture in Hong Kong and the US and reported that for men and women aged 85 years or over, the rates in Hong Kong were roughly one-third those in the US.

## The Role of Calcium

The American Academy of Orthopaedic Surgeons (AAOS) calculates the average cost of a hip fracture to be \$33,000 per patient<sup>4</sup>.

Bone is the major reservoir for calcium, accounting for 99% of total body calcium. The skeleton contains about 25gr of elemental calcium at birth and increases up to 30-40 fold at maturity. Skeletal losses of calcium occur in the elderly and particularly in women in the years following the menopause. Indeed, women with hip fracture may have lost 50% of total body calcium<sup>5</sup>.

In the United States the RDA (recommended dietary allowances) for calcium is 1,200 mg/day. The daily calcium intake in Western countries is about half of the RDA. The relatively low calcium consumption in the West prevents women from reaching

the maximal bone mass and therefore puts them at greater risk for osteoporosis. To reduce this risk there is a need for calcium fortification. In order to make a health claim, manufacturers must add at least 10% of RDA of calcium per serving, claims Saul Koder, V.P. of Business Development at Gadot Biochemical Industries. "The fundamental feature in choosing the best source of calcium is bioavailability".

## Calcium Citrate

According to recent studies, organic calcium like citrate, gluconate, and lactate are more bioavailable than inorganic calcium like carbonate and phosphate.

A study conducted by Heller H. J. et al<sup>6</sup> on 25 postmenopausal women suggested that estrogen treatment or vitamin D status may affect the bioavailability of two common calcium supplements: calcium citrate and calcium carbonate. Authors found that DELTA AUC (Area Under the Curve, a marker for bioavailability) of serum calcium after subtraction of placebo was significantly higher after calcium citrate than after calcium carbonate. Bioavailability was also significantly higher with the citrate salt for the sub-groups with lower serum 25-hydroxyvitamin D and higher serum 1,25-dihydroxyvitamin D concentrations. Researchers assumed that the low bioavailability of calcium carbonate supplement was due to its dependency on estrogen treatment and vitamin D status

compared to calcium cit-rate. A review of 15 studies has shown that calcium absorption from calcium citrate was consistently significantly higher than that from calcium carbonate by approximately 22% to 27%, either on an empty stomach or when coadministered with meals<sup>7</sup>.

## Hormone Replacement

Estrogen replacement, in particular, has been the mainstay of therapy for the prevention and treatment of osteoporosis in postmenopausal women.

Soy isoflavones are more commonly defined as natural 'selective estrogen receptor modulators' (SERMs). They are less potent than HRT (Hormone Replacement Therapy), but have greater tissue-selectivity. In light of recent negative reports on the major risk factors associated with HRT, women today are looking for the ideal natural and safe solution. Soy isoflavones tend to be the ideal 'phytoSERMs' because they provide the positive benefits associated with HRT (alleviate menopausal symptoms, reduce high cholesterol and prevent osteoporosis) without the added risks of breast and ovarian cancer, cardiovascular disease and strokes seen in the treatment with HRT. Soy isoflavones exert their beneficial effects on bones by several different mechanisms: building bone mass, suppressing bone turnover and enhancement of calcium absorption.

## Building Bone Mass

Many clinical studies have demonstrated that consumption of soy isoflavones either in foods or in supplements may not only prevent bones from breaking down but also help building new bone cells in menopausal and perimenopausal women<sup>8-10</sup>.

One of the major outcomes of estrogen deficiency is a negative calcium balance leading to secondary hyperparathyroidism, which in turn contributes to an increase in bone turnover<sup>11-12</sup>. HRT prevents postmenopausal osteoporosis, by suppressing secondary hyperparathyroidism and bone turnover<sup>13</sup>.

There is extensive evidence that estrogen acts by binding to estrogen receptors on the osteoblasts<sup>14</sup>, directly modulating osteoblastic activity and indirectly regulating osteoclast formation to reduce bone turnover or inhibit bone resorption. Isoflavones have a greater affinity for estrogen receptor  $\beta$ <sup>15</sup> (abundant in bone tissue) and thus might exert similar beneficial effects on bones.

## Calcium Absorption

It has been reported that osteoporosis arises not only due to a decrease in calcium intake but also due to a decrease in intestinal calcium absorption<sup>16</sup>.

The protective effect of ipriflavone (IP), the synthetic isoflavone drug, may be partly due to its ability to enhance calcium absorption. Recently, an in vitro study showed that IP, although less potent than estrogen, significantly enhances calcium uptake in the duodenum, the active site of calcium absorption<sup>17</sup>.

The role of soy isoflavones on intestinal calcium transport was examined using ovariecto-

mised rats. Results showed that soy isoflavones might promote calcium absorption in a manner analogous to that of estrogen but without exerting any negative hormonal effects on the uterus<sup>18</sup>.

In summary, numerous studies suggest that soy isoflavones, stimulate bone formation, suppress bone resorption and enhance calcium absorption. Soy isoflavones can be used in nutritional supplements, beverages and food as one of nature's best solution for building strong bones and preventing osteoporosis.

## Calcium Fortification

One of the hottest segments in the nutraceuticals market is that of functional beverages.

Gadot Biochemical Industries Ltd has developed a series of customised calcium products for various food applications such as beverages & dairy products. Choosing the right source of calcium becomes a major issue for beverages producers.

To achieve a clear solution, highly soluble calcium such as calcium gluconate or calcium lactate is required. "Gadot has developed a highly soluble calcium citrate, Gadocal+, for beverage applications", says Saul Koder, V.P. of business Development for Gadot Biochemical Industries. "In applications that already include citric acid, Gadocal+ can replace citric acid in a relation of 5:1 gr". As a matter of fact, the disadvantage of calcium gluconate, calcium lactate or Gadocal+ is the small content of calcium, which makes it difficult to meet the RDI (Recommended Daily Intake). Gadot developed another tailor made solution, which can meet 30% of the RDI. By processing equal particle size



of calcium citrate through micronising, juice producers are able to create stable sustention without sinking or grainy mouthfeel. "We are aware of the customer's needs for tailor-made ingredients, that will give added value for the consumers while function as an essential part in the beverage without any side effects such as taste, color or mouthfeel," added Koder.

## Beverage Applications

Soy drinks dominate the European non-dairy drinks market. Soy milk is the most commonly used dairy milk substitute and improvements in taste & quality have broadened consumer demand<sup>19</sup>. Some of the new soymilk products have been developed with soy protein concentrates and isolates.

Another segment that recently showed interest in fortifying with soy-based ingredients is the juice market. While calcium becomes an essential ingredient in juice fortification, soy isoflavones might be the trendiest ingredient in women's health fortification. SPE (Solbar

Plant Extracts) has developed Solgen 10/S, a readily soluble soy isoflavones concentrate. Soy isoflavones remain stable up to temperatures exceeding 200c. Solgen 10/S can be used also in meal replacement and supplement powders.

Gary Brenner, marketing director at SPE, explains, "It can be used to fortify a variety of functional beverages, including fruit juices, soy milks and instant powders. A typical formulation using Solgen 10/S could provide a daily intake of 20-30 mg". ♦

*A full list of references for this article can be found at [www.foodingredientsfirst.com](http://www.foodingredientsfirst.com)*