

Plant-Based Calcium:

Innovation in food enrichment and beverages



Calcareous algae have in its composition around 76 different elements and proportions that are totally bioavailable because it is a vegetal organism. They are complex biominerals that have mainly calcium and magnesium, and also elements such as zinc, phosphorus, potassium, iron, manganese, sulfur, and iodine are present in smaller quantities or in traces. Calcium bioavailability is defined as the fraction of dietary calcium that is potentially absorbable by the intestine and can be used physiologically as bone mineralization, or limitation of bone loss.

Given the high presence of milk in meals and products consumed daily and people who follow a dairy-free diet, it is necessary to seek alternatives to replace this product in daily meals.

It is important to highlight that consumers seek an option to be used as a substitute for cow's milk with similar sensory aspects regarding color, texture and, when possible, taste. However, often the nutritional characteristics of milk replacers are not similar to cow's milk. Thus, in addition to its ingestion as a food supplement, the enrichment of vegetable beverages with seaweed are currently practical and quite effective options with regard to the enrichment of minerals while maintaining the guarantee of nutrients required for this diet, especially calcium, a mineral normally obtained from dairy bases.

The application of vegetable calcium from *Lithothamnion calcareum* seaweed can be considered as an innovative option ensuring, in a single ingredient, the best absorption rates, bioavailability, and the natural presence of other essential minerals than calcium alone. As cited in research conducted by Paul, A., et al, 2019, and more recently by authors Vanga S.K., Raghavan V., 2018 the demand for plant-based beverages has been increasing worldwide over the years due to their potential health benefits and the growing adoption of a dairy-free diet.

The annual growth rate is estimated to be 10.18% between 2020 and 2024.

Plant-based beverages have varying composition in the amount of macro- and micronutrients and the presence of bioactive compounds.

Lithothamnium calcareum algae can be widely applied in the food segment with various functions.

It can be considered a functional ingredient, which can be used to enrich formulations, provide highly bioavailable antioxidants, do not alter taste and do not contain antinutritional factors (phytates, oxalates, tannins and other phenolic substances) besides having irrelevant caloric and fat content.

Technological interventions are being studied to improve the sensory acceptability and nutritional quality of these beverages.

Considering the scarcity of scientific studies comparing the nutritional composition of different milk substitutes of animal origin, to guide the population on the best alternative to compose your diet, this article examines the nutritional aspects of plant-based beverages used as substitutes for cow's milk and presents the use of plant-based beverages as an important consumption option to meet the growing demand for this product in the consumer market.

Calcium Supplements from Algae x calcium from mineral origin

Red algae calcium supplements are made from the calcified remains of red algae, *Lithothamnion calcareum*.

The algae itself naturally collects mineral from the sea during its life and at the end of its life cycle leaves behind skeletal remains that contain calcium, magnesium, iron, and various other minerals that are excellent for bone tissue and overall health.

On the other hand, most of the calcium in traditional dietary supplements is pure calcium carbonate, from limestone and other inorganic sources. It is produced by extracting calcium carbonate from the inorganic source through a complex process involving the use of large amounts of chemicals and then purified to contain almost only calcium carbonate, which is put into capsules or pressed into tablets for human consumption.

Although red mineral algae dietary supplements are also primarily calcium carbonate, they contain a considerable amount of other minerals derived from the sea where the algae live. These additional minerals are believed to be the cause of the extra benefits gained from consuming red mineral seaweed supplements compared to most regular calcium supplements.



Why use beverages with calcium from plant sources?

For adults, the daily calcium recommendation is 800mg to 1000mg depending on age and sex, according to the Dietary Reference Intakes. One of the main reasons for seeking an efficient intake of this mineral is to prevent symptoms resulting from its deficiency, such as osteoporosis.

The nutrient can be ingested in other ways, such as dark green leaves. However, the preferred source of the nutrient by the population is still milk, thus emphasizing the importance of fortifying vegetable versions.

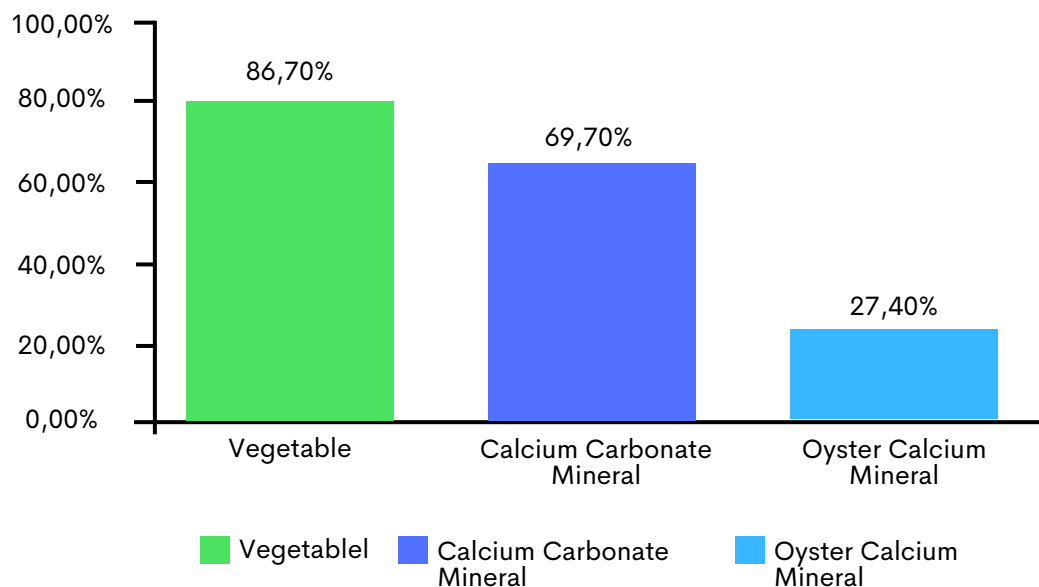
In Brazil we find mineral source versions of calcium for this fortification. Two of them are quite common: calcium carbonate salts (bioavailability approximately 69.7%), and tricalcium phosphate (lower bioavailability, 38%).

Both have similar or better forms of absorption compared to milk, which has a bioavailability of 32.1%. And they have contraindications, such as the accumulation of the mineral in the artery walls.

An alternative that presents superior quality in relation to bioavailability by the body would be the use of calcium of vegetable origin from the algae *Lithothamnium calcareum*, which has a relatively greater absorptive capacity, of approximately 90%, and has no contraindications.



Bioavailability of different calcium sources



Sources : UFMG – Instituto de Ciências Biológicas- 2012

The calcium found in the remains of calcified algae is no different from the calcium derived from limestone rock. However, there may be considerable differences in the way the digestive tract and the human body handle the calcium from these two very different sources.

The more complex mineralogical composition of the *Lithothamnium calcareum* sample leads to a richer chemical composition in Mg and trace elements compared to other samples.

Thus, under physiological conditions and in the pH range existing in the gastrointestinal tract (6.8 - 7.1), the calcium contained in the marine mineral concentrate product, in the form of calcium carbonate from plant sources, is largely absorbable by the body and represents a better source of calcium than commercial calcium carbonate (mineral) and oyster calcium (animal) products because they have a higher bioavailability of calcium.

Trace elements and their values are recognized by the European Food Safety Authority, which indicates how much the population should consume, in addition to calcium, regardless of its origin, to maintain a healthy diet.

The algae *Lithothamnium calcareum* is mentioned by Scholz-Ahrens et al., 2020 as another source of calcium added to plant-based drinks.

On average, 100 ml of plant milks fortified with *Lithothamnium* can provide 120mg of calcium from plant sources.

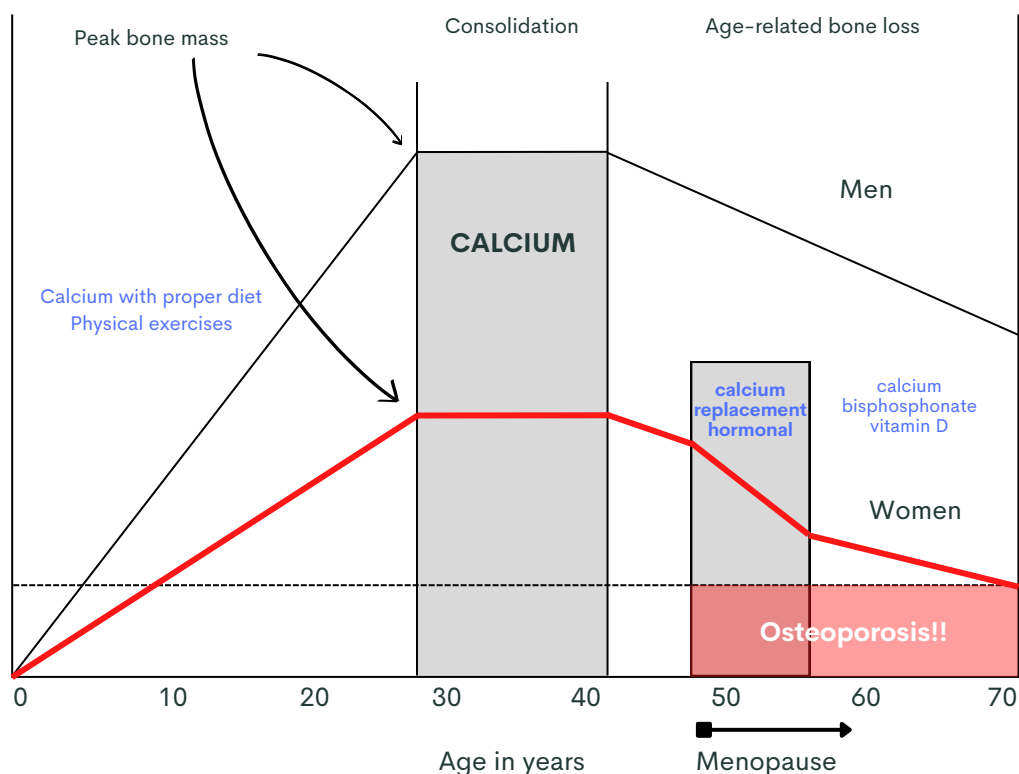
There are scientific studies showing that calcium from red mineral seaweed has a wide range of positive effects beyond the traditional kind, such as in the prevention of osteoporosis, osteoarthritis, and almost eliminating the formation of polyps in the colon.

Bone Density and Calcium

A highly interesting study suggests that calcium supplements from red mineral seaweed are able to restore bone density. How this happens is unclear and future studies are needed to determine the cause of this interesting effect, as it may have broad effects on the health of the elderly.

As can be seen in the graph below, bone density begins to decrease just after age 40 and women lose a significant amount of bone density between the ages of 50 and 60. Calcium replacement will become a primary recommendation for preserving and restoring bone mass.

Bone mass loss X Age X Sex



■ Preventive measures and treatment



Bone density peaks around age 30. Women lose bone mass faster than men. Regular supplementation of calcium from algae can reverse this trend. Less is more when it comes to plant-based calcium. The array of "auxiliary nutrients" that help your body absorb and use the calcium means that you don't need to take as much of this calcium every day as you would with other types of calcium.



Lithothamnium's differentials

- It has an absorption rate of over 87% by the human body.
- Organic minerals from seaweed are organized by the seaweed itself and are absorbed in their entirety.
- Because they are organic, Lithothamnium calcareum minerals do not cause deposits in the arteries, joints, intestines or kidneys. They pose no risk of heart problems or allergies.
- The organic minerals do not deposit in the microvilli of the small intestine like inorganic minerals, which can cause diarrhea or constipation.
- It has the proportion of minerals in balance, not allowing the bioavailability of one to interfere with the bioavailability of the other.
- It has lower molecular weight and higher solubility.
- Lithothamnium calcareum minerals are ionizable, most easily by the breakable ionic bond and its electrons rotate clockwise, as in human cells.

Characterization of the amino acid profile of the alga Lithothamnium calcareum.

Element	Concentration (mg/g)
Alanine	0,22
Arginine	0,28
Aspartic acid	0,53
Cysteine	0,45
Glutamine	0,10
Glycine	0,14
Histidine	0,16
Isoleucine	0,18
Leucine	0,12
Lysine	0,49
Methionine	0,40
Phenylalanine	0,18
Proline	0,19
Serine	0,19
Threonine	0,28
Tryptophan	0,07
Tyrosine	0,25
Valine	0,51

Source: LITHOLIFE Laboratory Analysis

Nutritional Profile Lithothamnium calcareum

100 g serving	
Energy value	28 kcal = 117 kj
Carbohydrates	7,0 g
Proteins	0,5 g
Sodium	347 mg
Calcium	32500 mg
Magnesium	3270 mg
Iron	77,6 mg
Fluorine	0,24 mg
Phosphorus	34,1 mg
Manganese	1,47 mg
Copper	72 mcg
Selenium	50 mcg
Potassium	38 mg
Molybdenum	151 mcg
Zinc	0,18 mg

Source: Nutrition Analysis LITHOLIFE

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