

## CONTRIBUTION OF MINERAL WATERS TO DIETARY CALCIUM INTAKE IN DIFFERENT AGE GROUPS

Pagano Imma<sup>a</sup>, Castaldo Giuseppe<sup>b,c</sup> and Rastrelli Luca<sup>a,c\*</sup>

<sup>a</sup>Department of Pharmacy, University of Salerno, Via Giovanni Paolo II 132, 84084 Fisciano (SA), Italy

<sup>b</sup>AORN San Giuseppe Moscati, Avellino

<sup>c</sup>NUTRIKETO-LAB Nutritional and Cosmetic Research Laboratory - University of Salerno - AORN Moscati of Avellino

[rastrelli@unisa.it](mailto:rastrelli@unisa.it)

### Abstract

Calcium intake is inadequate and below RDA (Recommended Daily Allowance) 800-1000 mg/die in different age groups. Calcium represents the most abundant mineral in our organism, especially in skeleton and teeth. Mineral waters high rich in calcium could give the correct amount, representing a highly bioavailable source.

**Keywords:** *Calcium, mineral water, Acqua Lete®*, adolescence, old age, pregnancy, lactation, sport.

## Introduction

Nowadays calcium intake is below RDA (Recommended Daily Allowance) 800-1000 mg/die for all population. In this contest, mineral waters high rich in calcium could give the correct amount.

Calcium is the most abundant mineral present in our organism, particularly in the bone where, together with phosphorus, plays a fundamental role giving mechanical strength to the skeleton and teeth and a primary role in the activity of the heart contraction, in the blood pressure control and blood coagulation; modulates the production of hormones; intervenes in the base and water acid balance regulation. Recently, its food intake is deficient in all age groups, especially in rapidly growing children and young people, in pregnant and lactating women, in adults, in athletes.

The absorption of calcium is regulated by vitamin D and it's influenced by numerous factors such as gastric acidity (a low acidity reduces calcium absorption), the intake of dietary proteins (high-protein diets reduce absorption), presence of fibers (which are able to modulate the absorption).

The intestinal absorption of calcium occurs in the first part of the small intestine by direct intervention of vitamin D.

In adolescents, consumption of milk (50% -75% of the daily calcium requirement) is often replaced by other drinks or new eating habits. Unfortunately, calcium deficiency predisposes to various diseases such as osteoporosis, kidney stones, cancer, hypertension, obesity and insulin resistance. In contrast to this trend, numerous strategies are recommended, even simply drinking mineral waters plenty in calcium. Supplementation with dairy products are difficult to achieve because of behavioural or environmental factors (Böhmer et al., 2000).

## Mineral water

Calcium is naturally abundant in some mineral waters which represent valuable caloric-free sources (Heaney and Dowell, 1994). Mineral waters with a high calcium content (over 150 mg/L) and low sodium content (less than 20 mg/L) are excellent supplemental sources.

Calcium of water is immediately used because is easily bioavailable. Some studies have reported the bioavailability of calcium in waters (Bacciottini et al., 2004; Van Dokkum et al., 1996; Wynckel et al., 1997; Couzy et al., 1995; Halpern et al., 1994). Numerous scientific works have shown that high-calcium mineral waters ensure calcium absorbability equal or even better than milk (Aptel et al., 1999; Heaney and Dowell, 1994; Heaney, 2006).

Heaney (Heaney, 2006) analyzed all data in literature and confirms comparable absorbability of calcium in both mineral waters and milk (obviously under the same

conditions). In most of the studied waters, the counterion of calcium is bicarbonate which is important because at the same ingested calcium load, it may vary its bioavailability (for example, the high-sulphate waters provoke a greater increase of urinary calcium.) Then high bicarbonate-calcium rich waters are preferable (Heaney, 2006).

Calcium from mineral waters can influence parathyroid hormone level, reducing its value and demonstrating its activity after ingestion (Guillemant et al., 2000).

Böhmer and co-authors analyzed six publications in literature regarding calcium absorption from mineral waters Van Dokkum et al., 1996; Wynckel et al., 1997; Couzy et al., 1995; Halpern et al., 1994; Guillemant et al., 2000; Heaney and Dowell, 1994). RDA are dependent on age and sex. Every phase of men's life has particular needs of calcium. Last studies reported 1000-1500 mg/die for children and adolescents, perimenopausal women and elderly. For these ages normal diet is not sufficient to ensure desirable calcium amount. It's necessary to integrate diet with dairy products and supplements, facilitating patient compliance. In this context, the calcium-rich mineral waters are inserted as alternative. Ingested calcium should be easily adsorbed and it's necessary to calculate and study the value of absorption fraction, defined as the relationship between absorbed calcium and dietary calcium intake. Böhmer and co-authors remind that absorption factors in calcium waters are similar to and in some cases even better than dairy products (Böhmer et al., 2000).

The presence of sodium negatively affects calcium absorption capacity.

There is a physiological correlation between calcium and sodium. Therefore people should be choosing low sodium water as hyposodic diets promote calcium absorption.

Scientific studies reported that sodium has a limiting effect on the calcium absorption capacity in the cells.

## Acqua Lete®

Among Italian mineral waters that possess the aforementioned characteristics Acqua Lete® allows an adequate calcium-supply (315 mg/L) easily absorbed and it is characterized by high CO<sub>2</sub> content, high bicarbonates (1020 mg/L) and low sodium concentration (5.15 mg/L) (Table 1). RDA calcium for an adult is 800 mg.

An habitual consumption of natural effervescent mineral Acqua Lete®, thanks to its high calcium value (315 mg/L) and the reduced sodium content (only 5.15 mg/L), is the most natural way to provide an adequate supply of calcium to our body. Bicarbonate waters may neutralize acid secretion, accelerate gastric emptying, provoke the release of gastric peptides and for these reasons are ideal for hydrochloric-peptic hypersecretion and gastro-

esophageal reflux disease. During sport bicarbonate waters are able to restore liquids and salts and counterbalance metabolic acidosis (Brancaccio et al., 2011).

In line with the classification of mineral waters under Dry Residue Acqua Lete® has average mineralization (dry residue 800 mg/L). The content of sodium ( $\text{Na}^+$ ) is less than 20 mg/L, suitable for low-sodium diets. Mineral water classification based on chemistry and related therapeutic effects (D.M. 29/12/2003) defines mineral content. Water is bicarbonate when the content of bicarbonate ( $\text{HCO}_3^-$ ) is higher than 600 mg/L. Moreover water possesses antiinflammatory action, if is bicarbonate – alkaline, instead is able to facilitate digestive process and antispasmodic if it is bicarbonate – calcic. Acqua Lete® presents as a negative prevailing ion bicarbonate and as positive prevailing ion calcium ( $\text{Ca}^{2+}$ ) is said water facies bicarbonate - calcic (Piazzese, 2015).

### Children and adolescents

Bones are the main site of calcium storage in the body and are no-stop remodeled and renewed, but the organism does not produce it: this is why it is taken through the diet or with a correct dietary integration.

To guarantee this mechanism, it is necessary a good intake of calcium. Bones are formed up to the age of 18-20 years, therefore children with adequate calcium values will have healthy bones. Despite this, many children do not take enough milk, because of taste, milk allergies or lactose intolerance (Henriksen et al., 2000). If they do not remedy with dairy products, other foods or mineral supplements, calcium deficiencies cause the poor absorption of calcium, the weak bones and growth problems (Black et al., 2002).

Black and co-workers reported serious damage to the skeleton in teenagers who have not consumed milk (Black et al., 2002).

At least 90% of the peak bone mass (the maximum bone mass reachable for an individual) is acquired at the age of 18 years. Therefore, in order to prevent osteoporosis in adolescent women, it is important that calcium deficiencies do not occur, because post-menopausal bone mineral density depends on the peak of bone mass (Winzenberg et al., 2006).

To reduce the incidence of osteoporosis recent challenges have reported the importance of achieving peak bone mass during childhood and adolescence, including recommendations to increase calcium intake in children as young as 6 y of age. Another study reported the benefits from higher calcium intakes,  $\leq 1350$  mg/die, were most apparent in pubertal than in pre-pubertal children (Abrams et al., 1997). During childhood and adolescence adequate  $\text{Ca}^{2+}$  intake represents the mainly prevention of osteoporosis.

Braun and collaborators determined calcium retention in adolescent boys in response to a range of controlled intakes and compared the intake needed for maximal retention in boys with that needed in adolescent girls studied under the same conditions. As results the higher calcium retention in boys than in girls was attained through higher net calcium absorption and lower urinary excretion (Braun et al., 2006).

Children aged 1 to 3 years need 700 mg of calcium per day while children and adolescents 9-18 years need 1300 mg (LARN IV REVISIONE, 2014).

It's necessary to correctly integrate the diet with calcium-rich foods. Therefore mineral waters may represent a highly bioavailable source of calcium.

### Adults

Low calcium intake provokes osteoporosis and numerous research papers confirm close correlation between calcium intake and fractures.

Our bones are no-stop renewed during the life. The integration of calcium is extremely important to avoid incidence of renal stones, hypertension and obesity, osteoporosis. The weakness of the bones begins in women with menopause and in men about at 55 years and is principle caused by lack of calcium and vitamin D. Osteoporosis can be reduced with an adequate supply of calcium, especially in women over 65 years (Dawson-Hughes et al., 1990). Cepollaro and co-authors, studied an important reduction of fractures in postmenopausal period, within a controlled trial clinical (Cepollaro et al., 1996). Now there is a clear benefit of a proper calcium intake for bone health, especially for women over 65. The role of calcium in adults as osteoporosis prevention is quite controversial, but several works in the literature confirm beneficial activity in women 65 years old during early menopausal with high calcium intake, reducing bone loss (Cepollaro et al., 1996). Therefore high calcium mineral waters represent a prevention tool in menopausal bone loss, especially for hip fracture in older women. Aptel and collaborators have shown that a woman with a consumption of 1 L/day of water rich of calcium, would have the same density as a woman of 7 years younger who drinks calcium-poor water (Aptel et al., 1999).

### Pregnancy and lactation

During pregnancy, the calcium requirement is 1200 mg a day to ensure important physiological and nutritional functions for mother and neonate.

Among the sources of calcium, mineral waters should not be forgotten: the waters with good content of calcium and low sodium help to provide a good percentage of calcium daily amount. For example 2 liters of Acqua Lete® during a day, thanks to its natural balance of calcium and sodium, provide about 630 mg of calcium. If intake levels

are inadequate, the mother's organism increases the rate of mobilization of calcium from her bones in order to maintain constant levels in the blood. This strategy predisposes to serious pathologies such as osteopenia and osteoporosis, risk of preterm pregnancies and birth of low weight newborns, risk of hypertension in pregnancy. The ideal calcium values are 1200 mg per day in pregnant women, 1000 mg during lactation and 800 mg in general. Epidemiological studies indicate high percentage of pregnant women take only 50-70% of the recommended dose, with consequent depletion of calcium from their bones (Kovacs, 2005).

During lactation women lose daily about 280 to 400 mg of calcium through breast milk. In case of deficiency, a process of demineralization of the skeleton occurs in order to satisfy the needs. About 5-10% loss of skeletal calcium content occurs during 6 months of exclusive lactation.

This demineralization is mediated by PTHrP (parathyroid hormone-related protein) released from the breast tissue, combined with the effects of low estrogen levels on bone turnover.

Finally, the fetal calcium derives from intestinal calcium absorption, which more than doubles from early in pregnancy. During lactation skeletal calcium resorption is the principle mechanism but calcium levels are completely restored to the skeleton after weaning (Kovacs, 2005).

### Sport

The reintegration of mineral salts is essential before, during and after sport. Mineral water can help the recovery. Acqua Lete®, thanks to its high content of bicarbonates and calcium and their combined action, is optimal for muscle recovery and perfect rehydration.

Brancaccio and co-authors have shown the influence of Acqua Lete® hydration on blood lactate after exercise. This study reported the effects of Acqua Lete®, bicarbonate calcic mineral Italian water ingestion on blood lactate, glucose, and serum lactate dehydrogenase. All the 88 amateur athletes hydrated pre-exercise with Acqua Lete® showed a significant decrease in blood lactate levels post-exercise and also changes in LDH isoenzymatic pattern compared with athletes hydrated pre-exercise with a low mineral content water. This study investigated the effectiveness of a hydration strategy prior to exercise. Acqua Lete® possesses exclusive mineral ion composition and shown to improve the restore due to its buffering capacity. These results promote habitual consumption of Acqua Lete® as valuable nutritional vector for influencing the restore and hydration status in athletes (Brancaccio et al., 2011).

In other study Brancaccio and collaborators shown results regarding the supplementation of Acqua Lete® (Bicarbonate Calcic Mineral Water) with improved

hydration status in athletes after short term anaerobic exercise. In particular, mineral waters with high concentrations of calcium and bicarbonate are able to impact acid-base balance. In this study all the athletes hydrated with Acqua Lete® showed a positive impact on hydration status, after anaerobic exercise with significant decrease of specific urine gravity and a positive effect on pH. These effects can guarantee the effectiveness of a correct hydration during short term exercise (Brancaccio et al., 2012).

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**Table 1** Chemical characteristics of Acqua Lete® mineral water

Parameter	Measurement Unit	Acqua Lete®
Conductivity	µS/cm	1220
pH	pH	6.4
Fixed residue 180°C	mg/l	880
CO <sub>2</sub>	mg/l	1980
HCO <sub>3</sub> <sup>-</sup>	mg/l	1020
Cl <sup>-</sup>	mg/l	10.3
NO <sub>3</sub> <sup>-</sup>	mg/l	5.4
Na <sup>+</sup>	mg/l	5.15
K <sup>+</sup>	mg/l	1.9
Ca <sup>++</sup>	mg/l	315
Mg <sup>++</sup>	mg/l	13.5
SiO <sub>2</sub>	mg/l	12.4