Vitamin D in Dairy Products

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The term Vitamin D was created in 1922, describing a vitamin able to promote calcium deposition. Vitamin D in nature is available as ergocalciferol (vitamin D_2) or cholecalciferol (vitamin D_3).

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1. Introduction

Considering the essential role performed by this nutrient in calcium metabolism, appropriate amount of vitamin D is necessary for skeletal health during the entire life, and can be provided both from the diet or by cutaneous synthesis induced by sunlight. Vitamin D is synthesized in the skin through exposure to the sun-light, especially the ultraviolet B light of wavelength ranging between 290–315 nm, that are responsible of promoting the conversion of 7-dehydrocholesterol to provitamin D. Vitamin D synthesis induced by sun-light is strictly correlated with the season during the year, the time during the day, the period of exposure, the skin pigmentation and the different latitude. In fact, in extreme latitudes such as beyond 35N or S, vitamin D synthesis is greatly reduced or does not occur during winter season. Moreover, skin synthesis of vitamin D decreases with advancing age, consequently in elderly is higher the percentage of people with low vitamin D levels. Therefore vitamin D dietary intake must increase in elderly, but it is not easy to fulfill this target if the diet is not characterized by vitamin D-rich foods. Fatty fish, fish liver oils and egg yolk represent the most important natural dietary sources of vitamin D, but these foods are not so frequently eaten by most of the people; in meat and offals vitamin D content is normally low.

2. Cow Milk

Dairy cow breeding started around 5000 years ago during the late Neolithic and early Bronze Age in northern and central Europe. “Milk” is normally associated with cow milk; however, milk from other animal species is also consumed. Milk is a complete food providing several nutrients, specifically carbohydrates (mainly lactose), proteins, fat, minerals, and vitamins, contributing a mean daily intake of 134 kcal, 8 g of proteins, and 7.3 g of fat to the average human diet. Water is the most represented compound in all different milks, ranging from water content lower than 50% in whale milk to water content of around 90% in donkey milk.

Milk is a natural source of calcium and vitamin D; these nutrients have a synergic interaction in the human body. If the level of ionized calcium in the blood falls, the parathyroid hormone is secreted by the parathyroid gland, stimulating the conversion of vitamin D to its active form, calcitriol (1,25-dihydroxyvitamin D) with a consequent decrease in vitamin D status, determined by measuring the amount of the inactive form. Vitamin D, as calcitriol, influences calcium absorption in the intestine, and lack of vitamin D is associated with a reduced absorption of dietary calcium.

Dietary intake of vitamin D through dairy products, first of all obviously milk, has been investigated in-depth over the last 60 years. In the 1960s, vitamin D content in cow milk was determined to be in the range of 0.125–1 g/L, while a value of 240 IU per liter was detected in cow milk for vitamin D activity, 85% of which is water soluble, attributed to vitamin D3-sulphate. Vitamin D content can be described using different units: micrograms (µg) or International Units (IU); the most common unit used in Europe to describe vitamin D content is µg, while to convert µg to IU, the content in µg must be multiplied by 40.

2. Human Milk

Human milk contains 24,25-dihydroxycholecalciferol and 1,25-dihydroxy vitamin D3; vitamin D content in human milk is considered very low. A study on 198 children, followed up to 9 years of age, evaluated the effect of maternal vitamin D status during pregnancy on childhood skeletal growth. Results obtained in 9-year-old children fed by mothers who had vitamin D insufficiency (25 OHD levels < 40 nmol/L, 31%, n = 49) or vitamin D deficiency (25 OHD levels < 25 nmol/L,

18%, *n* = 28) during late pregnancy showed lower whole body and lumbar spine bone mineral content (BMC). According to the results of this study, vitamin D supplementation is recommended in pregnant women, especially in the winter months, when sunlight is less. The most important result obtained is the long-lasting positive effect on peak bone mass (PBM) attainment, together with a reduced risk of osteoporotic fracture in older patients[1].

3. Donkey Milk

A recent study determined total vitamin D content in donkey milk (23 mg/L, about 920 IU/L); it was found to be higher compared to the values obtained by analyzing milk produced by several mammalian species, including human milk. Even if donkey milk represents a niche product, its use is recommended for consumers at risk of nutritional deficiencies, such as children and/or elderly; in these patients, donkey milk could help prevent lack of vitamin D.

4. Cheese

Milk consumption has decreased in recent years, and dietary intake of vitamin D by way of fresh milk has declined, while cheese consumption has significantly increased (by almost 100%) since 1980. The big increase in human population and change in food consumption habits has created the right conditions for production of new fortified foods able to provide the recommended intake of vitamin D in the human diet. Milk does not provide the dietary requirements of vitamin D (Table 1), while cheese represents the right kind of food for the recommended dietary intake of this nutrient; in the States, the fortification level of vitamin D in cheese is strictly regulated by the U.S. Food and Drug Administration.

Table 1. Natural vitamin D content (µg/100 g) in food.

Foodstuff	Vitamin D
Whole milk	0.1
Cheese, cheddar	0.3–0.6
Yogurt	0.1
Butter	1.5
Egg yolk	4.9–5.4
Mushrooms, chanterelle	5.3–14.2
Cod liver oil	210–250
Salmon, wild	13.1–24.7
Salmon, farmed	6.0
Herring	5.7–15.4
Cod	Trace-2.6
Sole	Trace-2.8

In patients with osteoporosis, treatment with drugs is the best approach to decreasing the risk of other fractures. However, even in these patients, the importance of nutrition should be taken into consideration, because inadequate intake of Ca, vitamin D, and proteins may reduce the efficacy of anti-osteoporotic drugs. In one study, 37 elderly women with vitamin D deficiency received fortified soft plain cheese; the dairy product provided 17–25% of the recommended dose of vitamin D

(10–15 mg) and 25% for both Ca (1200 mg) and proteins (1 g/kg body weight). With daily consumption of two servings of soft plain cheese for one month, the vitamin D supplement caused a small increase in serum 25(OH)D. The results obtained in this clinical trial demonstrated that fortified soft plain cheese consumed by elderly women with vitamin D deficiency can reduce bone resorption, positively affecting Ca and protein metabolism, analyzing the decrease in PTH and increase in IGF-I, respectively.

References

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