

# **THE PERSPECTIVES OF APPLICATION OF VITAMIN D IN THE TECHNOLOGIES OF PRODUCTION OF BAKERY PRODUCTS WITH FUNCTIONAL PURPOSES**

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**Abstract:** Low vitamin D intake and status have been reported worldwide and many studies have suggested that this low status may be involved in the development of several chronic diseases. There are a limited number of natural dietary sources of vitamin D leading to a real need for alternatives to improve dietary intake. Enhancement of foods with vitamin D is a possible mode for ensuring increased consumption and thus improved vitamin D status. The present review examines studies investigating effects of vitamin D enhanced foods in humans and the feasibility of the approach is discussed.

**Keywords:** vitamin D; 25(OH)D; enhanced foods; fortification.

**The general adjustment of the problem.** In the modern world, metabolic diseases of skeleton are more serious issues comparing to cardiovascular, oncological problems, and diabetes mellitus. Nowadays, one can refer to the metabolic disorders the following diseases, such as osteopenia and osteoporosis that can constantly reduce bone mass and destructively influence the changes of bone tissues. These body changes can lead to fractures, even in case of a small injury. Moreover, the loss of bone mass and bone fractures can significantly deteriorate patient's life and health, and negatively influence the circulation of other diseases [4, 20,23, 27-29].

Undoubtedly, the issues concerning to the structural dysfunctions of bone tissues are identified as the urgent problems in the modern science and medicine [11].

Nowadays, osteoporosis is determined as a secondary disease that consists of heterogeneous group of conditions with different pathogenetic facilities and

reasons that could be connected. This group includes the following issues, such as [5]:

- ✓ The impairment of calcium metabolism;
- ✓ Endocrine deteriorations;
- ✓ The disease of digestive apparatus;
- ✓ Chronic and metabolic illness of kidneys;
- ✓ The disease of other organs and systems;
- ✓ The use of some medical remedies.

Indisputably, the issue relating to osteoporosis is a core global problem. The World Health Organization (WHO) points out that this problem is the most serious issue in the modern civilization. According to the statistics, the sickness rate of osteoporosis is yearly increasing. In this case, the problems that connect to this issue are growing, because of the increase of life expectancy [9,10,13,15]. It is important to mention that these problems seriously influence female health. Nowadays, an average Ukrainian woman lives till 70 years (in Europe – till 80). This statistics demonstrates that more than 20 years of female life are determined as a period of post menopause and a period of summary loss of bone mass. In this case, women can suffer from a high risk of fractures: vertebrae, armlet, and femoral neck [8]. Osteoporosis is identified as a destructive and progressive disease. Furthermore, it is determined that the death rate of women who suffered from vertebrate fractures, owing to diseases of cardiovascular, cerebral, respiratory and urino-genital systems, septic conditions and bedsores is highly increasing till 8 times, in case of fractures of femoral neck, it can grow to 6 times. The other patients live, suffering from physical and psychological problems.

The main task of treatment of osteoporosis is the normalization of bone remodeling procedures. In this case, it is highly recommended to oppress speeded bone resorption and to stimulate bone formation. Thus, this will lead to the stabilization and improvement of bone quality and reduction of the injury rate.

It is known that proliferation and differentiateion of osteoblasts, the synthesis of specific albumens, enzymes, and mineral bone metabolism are firstly

regulated by the active metabolites of vitamin D that reduce resorption of bone tissue and facilitate the mobilization of into bone [6,22,24,29].

The main means of influence of vitamin D on the mineral metabolism of bone:

1. The induction of albumens that actively precipitate the absorption of calcium in the lumen of the digestive tract. Additionally, vitamin D stimulates to the intense absorption of phosphates. This mechanism can be implemented after the junction of ligand  $1,25(\text{OH})_2\text{D}$  and the receptor of vitamin D (VDR). In case of hypovitaminosis of vitamin D, only 10-15 % of calcium can be absorbed into the lumen of small intestine. However, at the same time, when the level of vitamin D is sufficient, absorption is increased up to 2-3 times.

2. The maintenance of the level of calcium in blood plasma, even if it is absent during food consumption: vitamin D stimulates osteoblasts to the production of RANKL (receptor activator nuclear factor- $\kappa\text{B}$  ligand). RANKL stimulates to the osteoklastogenesis and to the activation of resorption of bone matrix with the help of influence on inactive osteoclasts. In this case, it is highly recommended to have not only vitamin D, but also parathyroid hormone in order to activate this mechanism.

3. It is known that vitamin D and parathyroid hormone significantly influence reabsorption of 1% of calcium in the distal nephritic channels. It is identified that almost 7 gram of calcium is daily kept in the adult organisms.

According to the official conclusions of the European Foundation of Osteoporosis (EFO), prophylaxis should be the main priority in the course of the development of health care. WHO suggests that the development of global health strategy should be accentuated on the control of osteoporosis, distinguishing its three fundamental courses, such as prophylaxis, treatment, and observation [2].

**The goal and task of the article.** The goal of this article is to identify the appropriateness of enrichment of nutritive products with vitamin D.

In order to reach the goal of the article, it is important to point out the following tasks:

1. To conduct analysis of the existing methods of enrichment of nutritive products with vitamin D, identifying their positive and negative sides.
2. To indicate the appropriateness of bakery production with the enrichment of vitamin D.

**The content of this scientific article.** It is known that the prophylaxis of osteoporosis can be concentrated on the two courses. The first course is identified as the influence on the all human population in order to form bone skeleton with the higher volume of bone mass and mineral solidity. This course can be realized in case of healthy way of life, rational nourishment, denial from bad habits, and diminution of pathogenic causes of osteoporosis. The second course is determined as the influence on humans who are more inclined to have bone fractures. In this case, the prophylaxis of falls will be an effective tool for the people of old age. Undoubtedly, there are non-medicamentous and medicamentous methods of prophylaxis of osteoporosis. It is known that a special diet with a certain volume of calcium, vitamin D, albumens, phosphorus, magnesium, zinc, copper, boron, vitamins A, C, K are referred to the non-medicamentous methods.

It is recommended to maintain the sufficient insulation in order to have a normal rate of vitamin D in blood, adequate physical work load, prophylaxis of falls, and to conduct educational programs of osteoporosis to humans. If to take into account pharmacological courses, it is recommended to maintain the regulation of vitamin D and shortage of calcium, and also to make correction of osteoporosis syndrome of different origins [14,25].

Indisputably, rational nourishment plays a significant role in the prophylaxis of osteoporosis. It is especially vital at the old age, when the provision of calcium and vitamin D is in a high need. According to the international recommendations, an adequate taking of remedies will positively lead to normal solidity of bone tissue and strengthen anti- resorptive effect of oestrogens on bones. In this case, it is a pivotal part of the treatment and prophylaxis of osteoporosis [2,19].

Statistically, only 20-30 % of vitamin D are received into the human organisms. Its main provider is products made from grain plants, cod-liver oil, dairy butter, margarine, milk, and vitellus.

Undoubtedly, human health depends on physical, neuropsychic, successful education, and balanced nourishment. In this, sufficient and balanced nourishment is not only a guarantee of the normal human development, but also it is a pivotal factor of food security in our country.

According to the expert data, health of Ukrainian nation highly depends on the quantitative indices (80 %) , the qualitative characteristics of nourishment, and the state of healthcare system (20 %). In this case, domestic products of nourishment can considerably increase the quality of demographic situation in the country, life expectancy, and general healthcare system.

The diet has a great influence on the health, ability to work and life expectancy. The majority of Ukraine's population consumes cheap products with low biological value but high energy consumption. According to recent studies it was found that the dietary pattern is determined by an increase of 38-40% fat component of the diet, mainly due to animal fats. Most of the carbohydrates (the main energy supplier for adult and child population) comes from cakes and pastry, and, of potatoes, 17% of the diet provided by sugar. In addition, the population of Ukraine feels a so-called "hidden hunger" due to deficiency of micronutrients in the diet: vitamins, especially vitamins A, E, C, D, macro-and micronutrients (iodine, iron, calcium, fluoride, selenium) [16,23,26].

In developed countries, the issue of nutrition comes first and its solution is taken care of by the state. In most European countries, USA, Canada and Australia nutritional problems of the population, according to the national programs have gained official status and are under the constant attention of the governments of these countries [4,18,21]. In these countries, the legislative system regulates the rules of fortification of food with vitamins, macro-and micronutrients.

It should be noted, that the decrease of the population which is characterized by low levels of vitamin D is a vital necessity in the above mentioned countries, as well as in our country.

Since the distant 1930s voluntary enrichment of milk with vitamin D has been playing an important role in the eradication of vitamin D-deficient diseases. Almost all milk in the U.S. is enriched with vitamin D. Vitamin enrichment is regulated by the FDA and only certain products are suitable and can be enriched with vitamin D.

So according to the Code almost all liquid milk, ready-to-eat cereal, yogurt, several cheeses, juices and spreads provide only 10-25% of the daily needs of the U.S. population for vitamin D.

The same trend as for the United States is typical for Canada, but doses of vitamin in foods are a bit bigger, because Canada's population compared to U.S. residents exposes to less sunlight and therefore a natural accumulation of vitamin D for the land of the maple leaf is less than for the USA.

Statistics for European countries:

- In Germany, there is a limited fortification of food with vitamins A and D and is mostly used for products such as dairy products, margarine, and only in amounts permitted by law.

- In the Netherlands, fortification of food with vitamin D, folic acid, retinol, copper and zinc was banned and is now made only with the authorization for certain specified products.

- In Scandinavia enriching with vitamin D is voluntary but the standard which is typical for this food is regulated by the state.

- In Finland, there is no compulsory fortification, usually only milk and margarine are enriched with vitamin D.

- In Italy, there is also no compulsory fortification, manufacturers only need to get permission for voluntary fortification of food.

- For Poland it is typical to enrich margarine with vitamins A and D of at least 15% of the daily requirement.

➤ In the UK, there is compulsory enrichment of white and brown flour with calcium and iron, and margarine with vitamins A and D.

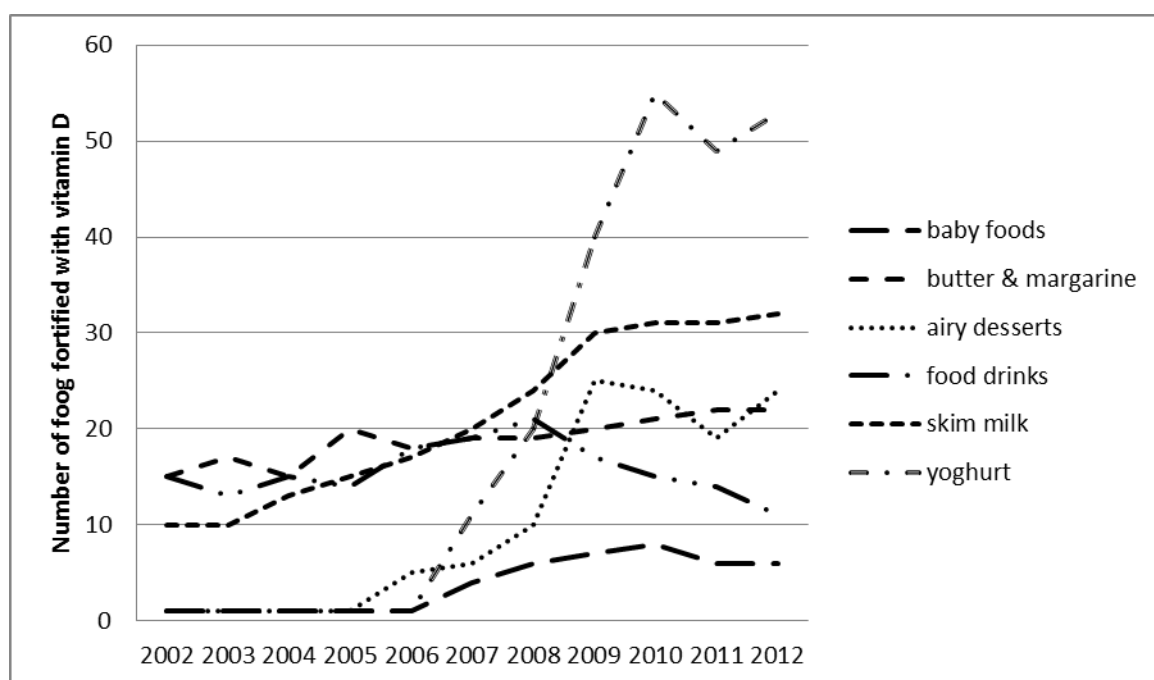
In Australia, the government mandated the enrichment of vitamin D of all kinds of margarine and it is required to add a small amount of vitamin to skim milk and some other dairy products.

*Table 1*

**Mandatory Certification**

Type of product mg/100 g	Canada	UK	USA	Australia
Margarine / Spread	13.25	7.05–8.82	N	5.5–16
Dairy Fresh	0.9–1.2	N	N	N
Dry milk products	0.9–1.2	N	N	N
Skim milk	0.9–1.2	N	N	N
Condensed milk	0.9–1.2	N	2.1	N

Примітка: N – not standardized.



*Picture 1 – The number of products fortified with vitamin D which is characteristic for developed countries.*

What is the trend characteristic for Ukraine? Currently the studying issues related to osteoporosis are of primary importance for the Ukrainian scientists since it was found that only 4.6% of the population of our country has normal

concentrations of vitamin D serum levels. At the same time 13.6% of people has deficiency, and 81.8% has a shortage of vitamin D [1].

However, despite the disappointing statistics in our country, our manufacturers and scientists are slowly solving the problem of diet fortification with vitamin D. Only a company "Bel Shostka Ukraine" enriches some kinds of cheese with vitamin D. So brand "Funny Cow" is able to satisfy 18% of the daily requirement of vitamin.

Analysis of fortification of foods with vitamin D showed that the most enriched foods are made from milk. Back in 1930 milk was chosen as the object of fortification, as it is a widely available product used in baby food, rich in calcium and phosphorus. Different kinds of cheese are also widely used as they are rich in calcium.

Although dairy products are often included in diets of the residents in vitamin D-deficient countries, they can not fully satisfy the need for this vitamin for the citizens of the U.S., Canada, Ukraine and Australia because there is a problem in attracting new food products that would be included in the daily diet and could satisfy the need for vitamin D.

It is shown that the current global trends in nutrition related to the creation of a wide range of functional products that are in daily use in the diet help to restore health and maintain it at an adequate level. Traditionally, the diet of the population of Ukraine includes much of foods from cereals and cereal crops and vegetables. Bakery is one of the most important foods. Nature has laid in wheat and rye grains range of essential nutrients: protein, carbohydrates, fats, vitamins and mineral compounds. Bread covers more than 30% of the calories in the body, the third - in proteins, more than half - in B vitamins, phosphorus and iron salts. Bread has many advantages: it is never boring, it is consumed by everyone all day and throughout life. The high digestibility of bread can be explained by the peculiarities of its chemical composition and availability of substances that are part of it. Proteins are denatured grain as starch, fat - in emulsions or in combination with proteins, carbohydrates and other components, dietary fiber - in a softened



condition. This state of ingredients makes them available to the enzymes of the gastrointestinal tract. Soft texture makes it completely assimilated, making it accessible to digestive juices.

The analysis of the range of bakery products showed that nowadays they are not produced enough. To extend the range of important products it is necessary to include natural products in recipes and not to use synthetic ingredients, such as flavorings, preservatives and antioxidants. Such scientific solutions reduce the risk of allergic reactions for people and provide an opportunity to improve the digestibility of nutrients. Considering all the above, the development of technologies of bakery goods for the population based on natural additives, which provide them with high quality and nutritional value, is an important task and it has practical significance.

### **Conclusion**

To achieve this goal you need to solve the following tasks:

- to point scientific justification of the choice of vitamin D for enrichment of bakery products including biomedical requirements;
- to develop recipes and technologies of bakery products enriched with vitamin D;
- to investigate the effect of vitamin D on biological and microbiological processes in the dough and its rheological properties;
- to investigate the quality of bakery products with vitamin D;
- to investigate the microbiological parameters;
- to develop technical documentation for bread fortified with vitamin D;

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