

LALLEMAND BIO-INGREDIENTS





Health Lallemand Ingredients

THE ROLE OF VITAMIN D

Vitamin D refers to a group of fat-soluble vitamins, mainly the two forms called vitamin D2 (ergocalciferol) and vitamin D3 (cholecalciferol). Vitamin D3 is produced when skin is exposed to sunlight, which is why it is also known as the "sunshine vitamin". Supplemental vitamin D is often found in the form of synthetic vitamin D3, which is made from sheep's wool subjected to several solvent extractions and chemical processing steps before being crystallized and irradiated. Vitamin D2 is a natural form of vegan vitamin D produced in some plants and in yeast simply upon exposure to UVB light. The best dietary sources are animal sources, including fatty fish, beef liver, cheese and eggs.

In the body, both vitamin D2 and D3 are converted to 25-hydroxyvitamin D or 25(OH)D also known as "calcifediol". It is the 25(OH)D which is measured by doctors when taking blood samples to determine a patient's vitamin D status. A healthy vitamin D status is critical for optimal health. Vitamin D plays an essential role in the regulation of calcium and phosphorus metabolism for bone health. Vitamin D receptors (VDR) can be found on tissues of intestine, bone, kidney, and parathyroid glands, where it regulates these minerals. VDR can also be found on non–calcium-regulating cell types including fibroblasts and keratinocytes of skin, immune cells, some cardiovascular cell types, and in cellular components of other tissues. This observation has made it clear that vitamin D activity in many cellular targets is unrelated to calcium and phosphorus regulation, suggesting that it has additional hormone-type functions.



Vitamin D is well known to regulate calcium absorption from the small intestine and stimulate healthy mineralization of bone and teeth. Deficiency in children will cause growth retardation and classic signs and symptoms of rickets (the softening and weakening of bones in children). In adults, vitamin D deficiency will precipitate and exacerbate both osteopenia (bone weakening) and osteoporosis ("porous" bone prone to breakage) and increase the risk of fracture.

STAGES OF OSTEOPOROSIS



Lallemand has developed a process that converts the naturally occurring sterols in yeast to vitamin D2. Subjected to UV-light under controlled conditions, the active yeast is able to produce Vitamin D2 from its endogenous ergosterol. **Lalmin® Vita D** is fermented, dried and inactivated whole cell yeast (*Saccharomyces cerevisiae*) containing naturally elevated levels of vitamin D. Naturally elevated levels of Vitamin D2 are standardized to contain 400 IU or 10 µg of Vitamin D in a 50 mg quantity. **Lalmin® Vita D** is a perfectly natural source of vitamin D. It is also vegan, unlike lanolin-derived D3.



LALLEMAND BIO-INGREDIENTS

Lallemand Ingredients

VITAMIN D HEALTH BENEFITS

In recent years, there has been a renewed interest in vitamin D. Besides bone maintenance, adequate blood levels of vitamin D may play a role in the reduction of risk of certain common cancers, such as breast and colon cancer. Increasing evidence shows that vitamin D is also beneficial for tissues such as the brain, heart, stomach, pancreas, lymphatics, skin, gonads, and prostate, which are composed of cells that express the vitamin D receptor. In these tissues, vitamin D is thought to play a role in improving immune function, reducing inflammation, and maintaining



normal cell division and muscle function. This could explain why lower serum 25(OH)D levels appear to be linked to increased risk of several chronic diseases, including cancer, cardiovascular disease, diabetes, and autoimmune diseases, as well as bacterial and viral infections.

NEW AND EXCITING RESEARCH CONTINUES TO DEMONSTRATE HOW ESSENTIAL AND VERSATILE VITAMIN D IS.

In January 2018, Krieger et. al. indicated that vitamin D deficiency during pregnancy is associated with negative health consequences for mothers and their infants. This has been previously noted in other research showing links between deficiency and preeclampsia, gestational diabetes and pre-term birth.

In February 2018, Mousa et. al. published a metaanalysis showing that vitamin D supplementation may reduce chronic low-grade inflammation in patients with type 2 diabetes. Jolliffe et. al. and Lu et. al. both recently indicated that vitamin D deficiency is common in children with asthma. Vitamin D sufficiency across three prenatal/ neonatal timepoints are associated with reduction of asthma or recurrent wheeze at three years of age. A 2018 study from Degerud et. al. in Norway indicates that plasma levels of vitamin D are inversely associated with cardiovascular mortality. People who have suffered from cardiovascular disease and have a normal intake of vitamin D reduce their risk of mortality as a consequence of the disease by 30 percent.

Martineau et. al. assessed the overall effect of vitamin D supplementation on risk of acute respiratory tract infection and determined that vitamin D supplementation was safe and it protected against acute respiratory tract infection overall. Patients who were very vitamin D deficient experienced the most benefit.



Health Lallemand Ingredients

VITAMIN D DEFICIENCY

Vitamin D deficiency has become a major public health problem at a global level. It is associated with cardiovascular disease, hypertension, stroke, diabetes, multiple sclerosis, rheumatoid arthritis, inflammatory bowel disease, osteoporosis, periodontal disease, macular degeneration, asthma, mental illness, propensity to fall, and chronic pain. Deficiency, therefore, has serious and wide-ranging implications.

For over 20 years, studies have been reporting on vitamin D deficiency among various demographics, worldwide. The table below indicates several major reasons for deficiency.

RISK FACTORS FOR VITAMIN-D DEFICIENCY		
Risk factor	Mechanism	
Lack of sun exposure	Avoiding sun exposure via behavior/clothing	
Latitude of residence	No skin synthesis of vitamin D from Nov - March at/above 52°north	
Sunscreen use	Increased use of high SPF sunscreens may prevent synthesis of vitamin D in the skin	
Skin pigmentation	Melanin is a very efficient blocker of UVB radiation	
Statin drugs	Cholesterol is required by the body to make vitamin D. Statin consumption lowers cholesterol and limits the body's ability to make vitamin D	
Urbanization	More time indoors and in automobiles limits sun exposure	
Aging	By age 70, skin production is reduced by 75% as the rate of institutionalization of the elderly increases	
Dietary deficiency	Limited access to vitamin-D rich foods (allergy, dietary restriction, etc.)	

Inadequate serum 25(OH)D levels is now a significant problem due to dietary insufficiency, seasonal limitation of sunlight, deliberate avoidance of sunlight through use of sunscreen or clothing, and an increase in the prevalence of obesity. The following table shows how serious the situation is, globally:

Country/ Region	Demographic	Prevalence of Deficiency [<20ng/ml serum 25(0H)D]
Shanghai	Males	30%
	Females	49%
Taiwan	Adults	31%
Australia	Adult Males	22%
	Adult Females	39%
UK	Adults	50%
Germany	Males	57%
	Females	58%
Spain	Adults	34%
Turkey	Adults	75%
North America	Adults	77%

Although there is no consensus on the optimal serum 25(OH)D level to maximize health benefits, there does seem to be consensus regarding what constitutes deficiency. Symptoms of deficiency are apparent at a serum 25(OH)D level of less than 20 nmol/L. Insufficiency is considered to be at a serum 25(OH)D level of 50 nmol/L or less.



Lallemand Ingredients

LALMIN® VITA D

Supplementation with **Lalmin® Vita D** is a reliable way to ensure adequate intake of vitamin D. It is a natural, vegan source of vitamin D2, with proven bioavailability. It is made simply by exposing active baker's yeast *(Saccharomyces cerevisiae)* to UVB light, then inactivating and drying it, resulting in a product containing elevated levels of vitamin D2. Then, it is standardized to contain at least 1µg of vitamin D2 per 2mg. All the other vitamins, minerals and micronutrients naturally found in yeast are also preserved. Lallemand Health Ingredients offers **Lalmin® Vita D** in powder form, suitable for tablets, capsules or for food fortification.



In 2014, the EFSA issued a marketing authorization for vitamin-D2-rich bakers' yeast for use in yeast-leavened bread, rolls, fine bakery wares, and food supplements. The new recent changes to the European Commission regulations allow manufacturers to maximize usage of this natural, source of vitamin D to meet the full adequate intake (AI) levels recommended by the EFSA. In the EU, AI for vitamin D remains at 15µg/day for adults, pregnant and lactating women and children aged 1-17 years. For infants of age 7-11 months, AI remains at 10µg/day.

SOUTHEAST ASIA

In Southeast Asia, the recommended daily allowance (RDA) is 5µg/day for infants, children and adults up to the age of 49. From age 50-65 the RDA is 10µg/day and for those older than 65, the RDA increases to 15µg/ day. Pregnant and lactating women have a RDA of 5µg/ day.

MALAYSIA

Malaysian recommended nutrient intake (RNI) for vitamin D is 10µg/day for infants (0-12 months), 15µg/ day for children, adolescents and adults (up to age 65). After age 65, the RNI increases to 20µg/day. Pregnant and lactating women are advised to consume 15µg/day.

CHINA

The RNI in China is 10µg/day for all adults.

TAIWAN

The Dietary Reference Intake (DRI) for Taiwan is 10µg/day for infants 0-12 months, 5µg/ day for children aged 1-18 and adults up to the age of 50. Adults 51 and older are advised to take 10µg/day.

AUSTRALIA

The nutrient reference values (NRV) for Australia and New Zealand advise 5µg/day for infants and children up to the age of 18 and adults up to the age of 50. At age 51, the NRV increases to 10µg/day and after age 70 it increases again to 15µg/day. Pregnant and lactating women are advised to take 5µg/day.

Different claims and dosages can be approved depending on the regulations in effect in each country. Check your local regulations before use.



Health Lallemand Ingredients

VITAMIN D YEAST

Vitamins D2 and D3

In 2011, a study group at Purdue University assessed the bioavailability and efficacy of vitamin D2 yeast in rats. The effect on plasma 25(OH)D after daily consumption of different quantities of crystalline D3 with equal amounts of D2 from bakers' yeast in bread was compared. It was shown than vitamin D2 rich yeast and vitamin D3 gave a similar increase in serum 25(OH)D levels. Further analysis showed that vitamin D2 yeast and vitamin D3 have a similar effect on trabecular bone.



Vitamin D2 yeast

In a 2010 study at the University of Helsinki in Finland, 38 healthy women were given either vitamin D2 yeast baked into bread or placebo bread + a vitamin D2 supplement (25 µg or 1000 IU for each person) daily for four weeks. Serum 25(OH)D concentrations were measured as a marker of vitamin D status in the body. The study showed:

- O Higher serum 25(OH)D levels from vitamin D2 supplement than from control
- O Higher serum 25(OH)D levels from vitamin D2 yeast bread than from control
- O No difference between the vitamin D2 yeast bread and the supplement

The results indicate that bread baked with vitamin D2 yeast had an equal effect on serum 25(OH)D levels as a vitamin D2containing supplement during a 4-week trial.

For more information, or to receive a sample of Lalmin[®] Vita D, please contact your Lallemand sales representative or distributor, or e-mail info@bio-lallemand.com



Lallemand Ingredients

REFERENCES

- 1. Aljohani, Naji J., Nutritional Deficiency, Chapter 9: Vitamin D Deficiency. Dr. Pinar Erkekoglu (Ed.), InTech. 2016.
- 2. Cashman et al. Vitamin D deficiency in Europe: pandemic? Am J Clin Nutr 2016;103:1033-44.
- 3. Chang et al. Vitamin D insufficiency and frailty syndrome in older adults living in a Northern Taiwan community. Archives of Gerontology and Geriatrics, Volume 50, Supplement 1, February 2010, Pages S17-S21.
- 4. Daly et al. Prevalence of vitamin D deficiency and its determinants in Australian adults aged 25 years and older: a national, population-based study. Journal of Clinical Endocrinology, Volume 77, Issue 1, July 2012. Pages 26–35.
- 5. Degerud, E. et al. Plasma 25-Hydroxyvitamin D and Mortality in Patients With Suspected Stable Angina Pectoris. J Clin Endocrinol Metab, March 2018, 103(3):1161–1170.
- 6. DeLuca, H. History of the discovery of vitamin D and its active metabolites. BoneKEy Reports 3, Article number: 479 (2014).
- 7. Ginde, et al. Demographic Differences and Trends of Vitamin D Insufficiency in the US Population, 1988-2004. Arch Intern Med. 2009;169(6):626-632.
- 8. Hohman, E. et al. Bioavailability and Efficacy of Vitamin D2 from UV-Irradiated Yeast in Growing, Vitamin D-Deficient Rats. J. Agric. Food Chem., 2011, 59 (6), pp 2341–2346.
- 9. Holick MF. Sunlight and vitamin D for bone health and prevention of autoimmune diseases, cancers, and cardiovascular disease. Am J Clin Nutr 2004;80:16785-16885.
- 10. Holick MF. High prevalence of vitamin D inadequacy and implications for health. Mayo Clin Proc 2006;81:353-373.
- 11. Holick et al. Vitamin D2 is as effective as vitamin D3 in maintaining circulating concentrations of 25-hydroxyvitamin D. J Clin Endocrin Metab. Dec 2007; 2290-2308.
- 12. Holick MF, Cancer, Sunlight and Vitamin D, Journal of Clinical & Translational Endocrinology (2014).
- 13. Jolliffe, D. A. et al. Prevalence, determinants and clinical correlates of vitamin D deficiency in adults with inhaled corticosteroid-treated asthma in London, UK. Journal of Steroid Biochemistry & Molecular Biology 175 (2018) 88–96.
- 14. Krieger, J-P. et al. Prevalence and determinants of vitamin D deficiency in the third trimester of pregnancy: a multicentre study in Switzerland. British Journal of Nutrition (2018), 119, 299–309.
- 15. Lehmann, et al. Bioavailability of vitamin D2 and D3 in healthy volunteers, a randomized placebo-controlled trial. J Clin Endocrin Metab. Nov 2013, 4339-4345.
- 16. Lu H-K, et al. (2012) High Prevalence of Vitamin D Insufficiency in China: Relationship with the Levels of Parathyroid Hormone and Markers of Bone Turnover. PLoS ONE 7(11): e47264.
- 17. Lu, M. et al. Prenatal and Neonatal Vitamin D Sufficiency Are Associated with Reduced Risk of Childhood Asthma/Recurrent Wheeze. American Journal of Respiratory and Critical Care Medicine 2018;197:A7255.
- 18. Martineau, et al. Vitamin D supplementation to prevent acute respiratory tract infections: systematic review and meta-analysis of individual participant data. | BMJ 2017;356:i6583.
- 19. Mousa, A. et al. Vitamin D supplementation for improvement of chronic low-grade inflammation in patients with type 2 diabetes: a systematic review and meta-analysis of randomized controlled trials. Nutrition Reviews, Volume 76, Issue 5, 1 May 2018, Pages 380–394.
- 20. Palacios, C. and L. Gonzalez. Is vitamin D deficiency a major global public health problem? J Steroid Biochem Mol Biol. 2014 October; 144PA: 138–145.
- 21. Peterlik M. and Cross HS. Vitamin D and calcium deficits predispose for multiple chronic diseases. Eur J Clin Invest 2005;35:290-304.
- 22. Peterlik M. and Cross HS. Dysfunction of the vitamin D endocrine system as common cause for multiple malignant and other chronic diseases. Anticancer Res 2006;26:2581-2588.
- 23. Pike, et al. The vitamin D receptor: contemporary genomicapproaches reveal new basic and translational insights. J Clin Invest. 2017;127(4):1146–1154.
- 24. Tangpricha et al. Vitamin D Insufficiency among Free-Living Healthy Young Adults. Am J Med. 2002 June 1; 112(8): 659–662.
- 25. Wacker, M. and Michael F. Holick (2013) Sunlight and Vitamin D. DermatoEndocrinology, 5:1, 51-108.
- 26. Wolf, G. The Discovery of Vitamin D: The Contribution of Adolf Windaus. 2004 American Society for Nutritional Sciences. J. Nutr. 134: 1299–1302, 2004.







ABOUT US

Lallemand Inc. is a privately held Canadian company, founded at the end of the 19th century, which specializes in the development, production and marketing of yeasts and bacteria. Today, Lallemand is present through plants, distribution centers or representation offices in 40 countries on the 5 continents.

Lallemand Bio-Ingredients (LBI) develops, manufactures and markets high-value yeast products from *Saccharomyces cerevisiae* and Torula yeast, including whole cell nutritional yeast, yeast extracts and yeast derivatives. The know-how and experience acquired since its beginnings, as well as its high quality, high production standards and technical knowledge have allowed LBI to increase its presence in the food, health and fermentation industries.

OUR MISSION

We take pride – individually and collectively – in the quality of our work, the advanced processes we use, the products and services we provide, and in the recognized and validated efficacy of our continuous improvement program. We take pride in meeting selected customer needs ahead of our competition. We take pride in achieving and sustaining levels of financial returns as a measure, beyond the numbers, of the value our customers agree we create.



