Vitamin D fortification of foods in India: present and past scenario

Author links open overlay panelYasmeena Jan a, Muneeb Malik a, Mifftha Yaseen a, Sayeed Ahmad b, Mohammad Imran c, Suhail Rasool d, Afrozul Haq a

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Abstract

India is a densely populated country known for its traditional, cultural and lingual diversity. In India Deficiency of vitamin D is seen in both the genders and among all the age groups. Micronutrient deficiencies are steadily adding to the increasing burden of health related co-morbidities with low dietary calcium and magnesium intake in Indian population. Despite lots of sunshine, vitamin D insufficiency is widespread in India according to the age and regions (50–90%). In order to increase vitamin D intake with normal diet, the food industry will have to find a more effective strategy to improve general health conditions. The breadth of widely used foods, including milk, cheese, margarine, dairy products, and various breakfast drinks, can improve the condition of vitamin D deficiency in Asian countries such as India. The requirements for calculating the necessary micronutrients and vitamin D fortification of foods and drinks, successful strategies should be developed and emphasized. There is need to improve the effectiveness of various fruit drinks through fortification of vitamin D, which can reduce vitamin D deficiency in the general population as well as in different age groups.

Introduction

Vitamin D is a seco-steroid hormone, and is a key regulator of bone metabolism, calcium and phosphorous homeostasis. The two noteworthy types of vitamin D are “Cholecalciferol”(vitamin D3) and “Ergocalciferol”(vitamin D2). Vitamin D2 (C28H44O) varies in structure from vitamin D3 (C27H44O) because of the side chain which is joined to the seco-steroid skeleton, containing an extra methyl group on 24th atom of carbon and a double bond is present between carbon 22 and 23 [1].The representation of vitamin D is usually expressed in“IU”(International Units) or in “μg”micrograms. IUs depend on anti-rachitic action estimated in biochemical assays utilizing rodents. According to World Health Organization (WHO)one IU of vitamin D is characterizes as the action delivered by 0.025 μg of crystalline vitamin D3[2,3], where 1 μg of vitamin D3corresponds to 40 IU. In spite of the fact that this definition depends on vitamin D3 activity, the change keeps on being summed up to the two types of the vitamin irrespective of the difference in their sub-atomic mass. Plasma concentration of 25-hydroxyvitamin D or 25 (OH) D or calcidiol, which is the key metabolite of vitamin D circulating in the blood and is typically expressed as “nmol/L”(nanomoles per litre) or “ng/ml”(nanograms per milliliter). The central wellsprings of vitamin D are sunlight (vitamin D3) and nourishments or dietary enhancements (vitamin D2). During the long periods from March to September, skin amalgamation is the principle source of vitamin D for many people.

Dietary sources of vitamin D comprise natural food sources such as: salmon fish, red meat, mushrooms, supplements and fortified foods. Naturally there are only few food sources that are rich in vitamin D. Breakfast cereals, dairy products, fat spreads and dietary supplements are fortified with either vitamin D2 or D3. The importance of dietary sources increases, when the intensity of solar radiations containing UV-B light is below desirable concentration during winters or exposure to sunlight is limited by avoiding outdoor activities [4].The active form of vitamin D3 is induced by ultraviolet (UV) B rays in the skin. Ultraviolet rays can be used for high dimensions between (10 a.m. to 3 pm). Metabolism of Vitamin D is first initiated in the liver to 25(OH) D which acts as a marker of vitamin D status in the human body. In the next step 25(OH)D in the presence of 1α-hydroxylase enzyme is metabolized in the kidneys and then converted to 125(OH)2D. Serum phosphorous, serum calcium, magnesium and plasma parathyroid hormone levels help in the regulation and production of renal 1, 25(OH)2 D [[5], [6], [7], [8], [9]].

The major source of vitamin D for people around the globe is sun and the considerable reason for vitamin D inadequacy is the limitation of our body’s exposure to sun light. Vitamin D insufficiency may result in a condition known as rickets in youngsters and will hasten and fuel osteopenia, osteoporosis, and bone fractures in grown-ups. Vitamin D deficiency has been related with expanded danger of regular malignancies, immune system ailments, hypertension, and infectious diseases [10]. Circulating level of 25(OH)D of 75 nmol/L, or 30 ng/mL, is required to augment vitamin D’s gainful impacts for wellbeing. Without sufficient sun exposure, at least 800–1000 IU vitamin D3/ day as supplement might be expected to accomplish sufficient levels in kids and grown-ups. Vitamin D2 might be similarly effective for maintaining flowing convergences of 25-hydroxyvitamin D when given in physiologic concentrations [10].The association of the essential micronutrient vitamin D is majorly associated with the diseases like diabetes [[11], [12], [13], [14]], Osteoporosis [15], cancer [[16], [17], [18], [19], [20]], and Cardiovascular Disease [21].

Vitamin D Deficiency is on an ascent as a foremost public health concern in India as well. Greater part of the populace in India lives in territories getting abundant daylight consistently; still vitamin D inadequacy is an issue of growing concern. Dark skin colour, poor sun exposure, vegetarian food habits and lower consumption of vitamin D fortified foods could be ascribed to the high pervasiveness of vitamin D deficiency in India [22]. However, till the mid-1990s, vitamin D deficiency was viewed as uncommon in India. Such conviction depended on studies estimating serum calcium and alkaline phosphatase in Indian populace. Till the year 2000, there was no methodical examination which specifically evaluated serum vitamin D status in India. An examination directed among sound subjects to measure their serum 25(OH) D level utilizing sensitive and specific assay which documented noteworthy hypovitaminois was present in up to 90 per cent of the subjects. [[23], [24], [25], [26], [27], [28]]. In this manner, studies led in various parts of the nation have recorded across the board commonness of vitamin D deficiency in all age groups including little children, younger students, pregnant ladies and their neonates and grown-up males and females living in provincial or urban zones [29].Broad commonness in India of vitamin D deficiency is undeniable. Truthfully, sun exposure is an unsound arrangement, for most people in India, towards achieving vitamin D adequacy. Low calcium and magnesium consumption related to vitamin D insufficiency exacerbates the situation. The requirement for development in vitamin D status of the Indian populace is both imperative and critical. The Indian government needs to take substantive measures towards this path. However, Food safety and standard authority has taken significant steps in fortifying oils and flour.

Food fortification or enrichment is the procedure of expansion of key nutrients and minerals to the staple sustenance’s their nutritional value and could address nutritional gaps in the population. The idea of food fortification is not new. The earlier evidence of food fortification dates back when Melampus a Persian physician in 4000 BC added fillings of iron to sweet wine to enhance the sailor’s resistance to arrows and spears and to increase sexual strength. Addition of iodine to salt synchronously commenced in the United States and Switzerland in 1920 [30,31]. This further proceeded with the addition of vitamin D and then Vitamin A to the dairy products by 1932 and by 1941 fortification of flour with thiamine started [30]. In western nation’s flour fortified with folic acid and iron started subsequently. Industrialized countries hold a long background of fortifying foods in order to control the inadequacies of vitamins A, B and D and other micronutrients like iodine and iron. In Denmark, vitamin A was added as a fortificant in margarine and in the United States vitamin D was added to milk with the purpose of controlling inadequacies of these micronutrients in the diet of people [31]. Foods for adolescents were strengthened with micronutrients especially iron, with the aim to diminish the menace of anaemia which is caused by iron inadequacy. In present scenario, folic acid addition to wheat has turn out to be prevalent in the America and this approach has also been adopted by many nations which include Canada, United States and Latin America. Fortification of foods in India started some 65 years ago in 1953 and the first product fortified was vanaspati with vitamin A [31] and salt was fortified with iodine in the late 1950s which had a significant role in uprooting goiter from India [32].

Considering, the present scenario of malnutrition and vitamin D deficiency in India food fortification will play a significant role in eradicating this menace. In India the focus of fortifying foods needs to be shifted towards fortification of staple foods. The staple foods of India chiefly include rice and wheat. The eastern and southern parts of India depend on rice whereas; the northern and western parts of the country depend on wheat. India is among the top rice-growing nations as production of rice in 2016 was 158.8 million tonnes. Considering, the global scenario, 30% of calories on an average are delivered from rice which could reach up to more than 70% in some low-income countries. In addition to this almost all vitamins and minerals of nutritional importance are lost due to the milling process [33]. In this way, rice and wheat could be astounding vehicles for conveying micronutrients. Despite the fact that in Indian context rice has been prescribed for iron, folic acid, and Vitamin B12 fortification, rice fortification with some other micronutrients such as vitamin B1, niacin, zinc, and in few cases selenium and vitamin A and E are also in practice [34]. In addition to the staple foods in India, oil is practically fundamental part of daily diet and it accounts about 99% of the households in India. The utilization of consumable (edible) oil in India is about 12–18 kg/per annum per individual therefore, oil is an appropriate vehicle for delivery of essential micronutrients such as vitamin A and D which are fat-soluble vitamins in nature [30].

Section snippets

Malnutrition

It is caused by the lack of vital nutrients necessary for the body growth and development in the diet. Nowadays, more than 2 billion people around the globe are subjected to essential trace nutrient deficiency which is mainly caused by dietary inadequacy of vitamins and minerals [[35], [36], [37], [38], [39], [40]]. There is an immense significance of these insufficiencies on the wellbeing specifically in expecting females and adolescent, as they cause harm to foetal as well as child growth [38

Fortification

Food fortification or synonymously “enrichment”, is defined by the codex general principles as “the addition of one or more essential nutrients to a food whether or not it is normally contained in the food, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups” [53].

The guidelines also state that the fortified food should be stable during all the unit operations including processing, packaging, storage,

Conclusion

Vitamin D insufficiency in India is a well-known fact and different approaches may be suggested to reduce the negative health effects of vitamin D deficiency. Vitamin D supplementation could prove as a useful tactic for overcoming the vitamin D deficiency and insufficiency among the masses. Keeping in mind India’s cultural, traditional and food diversity, one such approach is food fortification to solve the major issue of vitamin D deficiency. The food vehicles should be identified and doses

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