Review Article

International Journal of Food, Nutrition and Dietetics
Volume 8 Number 1, January – April 2020
DOI: http://dx.doi.org/10.21088/ijfnd.2322.0775.8120.6

Need of Milk Fortification and Indian Scenario

Vivek Sahu[1], Priya[2], Pratibha Yadav[3], Meena Goswami[4], Vikas Pathak[5], Barkha Sharma[6], Sanjay Singh[7]

How to cite this article:
Vivek Sahu, Priya, Pratibha Yadav, et al. Need of Milk Fortification and Indian Scenario. Int J Food Nutr Diet. 2020;8(1):45–49.

Abstract

There is a very heavy burden of vitamins deficiency in all age groups of population particularly in urban areas because of their lifestyle as they spent more time indoors so they get less exposed to sunlight and therefore become more prone to vitamin D deficiency. The need of fortification of milk feels as an alternative of the supplementary vitamin capsules. As a component of daily diet milk is the best way to supplement with additional vitamins to overcome the effect of deficiencies. Not only vitamins milk can also be supplemented with micronutrients like Fe, Zn and folic acid. As a developing country India has a higher proportion of anaemic population and people rely on milk for their nutrients but milk is deficient in iron and cannot compensate with daily iron requirements. Therefore, government is focusing on fortification as this is cost effective and do not require complex technologies for the addition of vitamins, it just require a premix of the vitamins and added before homogenisation and pasteurisation.

Keywords: Milk; Fortification; Vitamin A; Vitamin D, Deficiency; Life style.

Introduction

Fortified milk is that milk that contains extra vitamins and minerals that are not naturally found in milk in sufficient amount (FSSAI, 2019). Mainly Vitamin A and Vitamin D fortified milk is sold in the United States. Other nutrients like Zn, Fe, and folic acid can also be added to the milk. What kinds of nutrients are used for fortification of milk that depends on the country where you live? To fortify milk with Vitamin A palmitate and Vitamin D_3 are added because these are the most active and absorbable forms of these nutrients. Because of their tolerance to pasteurisation temperature, these compounds can be added to milk before pasteurisation and homogenisation. For the fortification of milk with Vitamin A and Vitamin D fat is necessary because these are fat soluble vitamins. Iron deficiency anaemia is a common problem especially in developing countries. Therefore, milk fortified with iron helps to fight iron deficiency anaemia. In these regions, milk is often fortified with iron and other nutrients, such zinc and B vitamins. Studied conducted in Pakistan showed that folic acid fortified milk helped improve the iron status of toddlers, compared with unfortified milk. Fortification was 1st developed to prevent nutrient deficiency diseases like rickets, a weakening of bones due to Vitamin D deficiency.

Earliest attempt for food fortification was made in 4000 BC by Persian physicians, Melampus, he added iron filings to the sweet wine to strengthen

Author Affiliation: [1]MVSc Scholar, Dept. of LPT, [4]Assistant Professor, Dept. of LPT, [5]Professor and Head, Dept. of LPT, [6]Assistant Professor, Dept. of EPM, [7]PhD Scholar, Dept. of LPT, College of Veterinary Sciences and AH, DUVASU, Mathura, Uttar Pradesh 281001, India. [2]PhD Scholar, Dept. of LPM, [3]MVSc Scholar, Dept. of LPT, Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh 243122, India.

Corresponding Author: Meena Goswami, Assistant Professor, Postgraduate Department of Botany, College of Veterinary Sciences and AH, DUVASU, Mathura, Uttar Pradesh 281001, India.

E-mail: dr.goswami2008@yahoo.co.in

Received on 17.02.2020, **Accepted on** 20.02.2020

the sailors' resistance to spears and arrows. Vitamin A was added in margarine in 1920s in Denmark. In 1924 iodine was first added to the salt on a voluntary basis in an attempt to address the prevalent health problem of goitre in United States. This initial fortification effort was followed in 1933 by the fortification of milk with Vitamin D based on recommendations of American Public Health Association, the Council on Foods and Nutrition of the American Medical Association (AMA), and the Committee on Food and Nutrition of the National Academy of Sciences. The addition of Vitamin D to milk was originally accomplished by irradiating milk or by feeding the cows irradiated yeast. This technique was replaced in 1940s by the simpler and more effective method of adding Vitamin D concentrate to milk, as is currently practiced today (Rajakumar et al., 2007)

Need of milk fortification

For over past half a century, the intake of dietary calcium, milk, milk products and cereals has declined drastically in the background of upward revision of RDA/RDI in modern India. This is attributed to changing life style, inadequate milk consumption across various socio-economic strata and shift in dietary intake from cereals to rice and wheat. The total population of India 960.5 million in 1995 went up to 1.35 billion in 2018. Due to industrialisation and introduction of machinery in the agriculture sector, agriculture became less intensive due to which there is a reduction in day-to-day energy expenditure. Due to modernization there is a sharp change in the lifestyle with long indoor working hours and changes in diet of erstwhile rural people with consumption of fast foods. Indians come under the skin class category V (dark skin) Mechanization of agriculture reduces the time spent under the sun. Due to modernization in culture, change in clothing habits, use of sunscreens of high SPF and prolonged indoor working hours leads to development of lifestyle disease i.e. hypovitaminosis D in India.

The dietary calcium deficiency (with declining dietary calcium intake in India) can lead to secondary hyperparathyroidism. This secondary hyperparathyroidism leads to increased conversion of 25(OH) D to 1, 25-dihydroxyvitamin D, thereby reducing the serum 25 OHD concentrations. The phosphaturia action of secondary hyperparathyroidism leads to low serum phosphorus and inadequate calcium phosphate ratio, resulting rickets in children and osteocalcin in adults. So, to combat this lifestyle diseases fortification of milk can be the best option. Fortified milk can also be a good alternative of the supplementary tablets of Vitamin D, calcium, iron and zinc. Also, these capsules and tablets can become toxic if consumed in large amounts. Unlike supplements milk fortification is a simple, preventive and low-cost approach to curb micronutrient deficiencies. This problem can also be overcome by the supply of fortified milk to children as a part of Integrated Child Development Scheme and mid-day meal scheme.

Indian scenario of milk fortification

But except for mandatory iodine fortification of salt, India lags in adopting milk fortification as a scalable public health intervention. This is a mis opportunity as a glass of fortified milk (320g) can provide approximately 34% of the RDA of Vitamin A and 47% of Vitamin D. In 2016, the Food Safety and Standard Authority of India released standards for the fortification of five staple food items: rice, wheat, salt, oil and milk. Further to that, regulations are now in place to fortify milk variants such as low fat, skimmed and whole milk with Vitamin A and D. Despite of its benefit effects milk fortification is not yet a common practice across the Indian Milk Industry. To cover this gap NDDB partnered with South Asia Food and Nutrition Security Initiative (SAFANSI), the World Bank and India Nutrition Initiative, Tata Trust to explore the possibilities of large-scale milk fortification in India.

The state of Jharkhand is one of the worst affected in India with acute Vitamin A and D deficiencies. Now the government of Jharkhand is pioneer in taking milk fortification. Himachal government launched fortified milk brand "Him Gauri" (with vitamin A and D) under state-run cooperative Milk fed in collaboration with TINI-Tata Trusts and NDDB. (FSSAI, 2019). Currently, 72 lakh litre per day (LLPD) of milk is being fortified by co-operative dairies and 15 LLPD by private companies in the country (FSSAI, 2018). Milk production in India, the world's largest producer 176 million tonnes (DHAD, 2017–18). Out of which, mere 22% of the milk from the organised sector is available for fortification. FSSAI has already set standards for fortification of milk and even a logo '+F' has also been launched for the same.

Fortification of milk with aloe vera

Lactobacillus bulgaricus and *Streptococcus thermophilus* are used for the preparation of yoghurt from buffalo and cow milk, with or without any additional food ingredients and permitted additives. The supernatant of fermented aloe vera with probiotic *Lactobacillus plantarum* HM218749 shows a very strong antioxidant property. The aloe fermentation supernatant can be used as functional beverage or cosmetic ingredients to guard human intestinal health, delaying aging and prevent chronic diseases (Jiang et al., 2106). There is no significant change in the pH and acidity of cultured buttermilk, prepared by fortification of aloe vera juice (5–20%). Aloe vera juice increase viscosity and reduced phase separation of the aloe vera fortified butter milk. Butter milk prepared with fortification of 10%aloe vera juice give highest sensory acceptability (Mudgil et al., 2016). Aloe vera fortified probiotic yoghurt on storage gives a reduced pH and count for Lactobacillus acidophilus and Bifidobacterium bifidum with an increased synergies effect with storage time. However, it shows good viability for the above probiotic culture (Panesar and Shinde, 2012).

Iron fortified milk

Iron deficiency anaemia affects up to two thirds of infant, children and women of a child bearing age in developing countries and up to one fifth in developed countries (Mc Lean et al., 2009). Iron fortification of commonly consumed foods may be the most effective supplementation method (Lynch, 2005). Due to widespread consumption iron enriched milk and dairy products have been proposed to be a good vehicle for iron fortification (Gaucheron, 2000). Iron fortified milk (Sazawal et al., 2010), cheese (Pizzaro et al., 2013) and yoghurt (Le porte et al., 2017) have been reported to effectively enhance iron absorption. Co-fortifying cow milk and dairy products with iron and ascorbic acid has been repeatedly reported to enhance iron absorption (Olivares, 1997). The bioavailability of iron within milk also varies significantly between species. Iron bioavailability has been reported to be higher in human milk compared to cow milk (Etcheverry et al., 2004). Goat casein micelles contain a higher proportion of β casein, the digestion products of which have been associated with augmented mucosal transport (Alferz and Lopez-Aliaga, 2006) and reduced iron mediated oxidation of milk (Smailowaska et al., 2017). Therefore, goat milk is strong candidate for iron enrichment.

The addition of ascorbic acid to either cow or goat milk significantly enhanced the iron dialysability and bioavailability compared to the ascorbic acid free milk treatment of either species. Ascorbic acid competes with iron chelators for soluble unbound iron but cannot displace iron once bound to high affinity chelators (Abbaspour et al., 2014).

Fortification of milk with phytosterols

Phytosterol lowers the cholesterol level when they are supplemented in diet. Phytosterols are a group of lipophilic steroid alcohols found in plants, have a molecular structure similar to cholesterol. The most frequently found phytosterols in nature are β-sitosterol, campesterol and stigmasterol (Langyel et al., 2012). These molecules are able to displace cholesterol during micelle formation in intestine due to their hydrophobicity, thus reducing cholesterol absorption (Calpe-Berdiel et al., 2009). Phytosterols are added in milk in oil-in-water emulsion. Phytosterols are made into a water-soluble form by emulsification can be applied in a wide range of food products. Some clinical trial results indicate that sterol-enriched milk and milk products are effective at reducing concentrations of serum cholesterol (Noakes et al., 2005; Goncalves et al., 2007; Garcia-Llatas et al., 2015). The oxidative stability of phytosterol in phytosterol- enriched dairy products was analysed by Soupas et al., (2006). They evaluated level of phytosterol oxidation products in phytosterol enriched milk powder (7% phytosterol) and heat-treated skim milk (0.4% free phytosterol, 0.5% phytosterol esters, 0.5% Phyto stanol esters) during processing and long-term storage. Phytosterol is reported to be a valuable nutraceutical substance. Since its level in the diet is low and milk is a food that is regularly used in the diet, fortification of milk with phytosterol could be used to increase dietary phytosterols. Phytosterol being a high melting substance with a poor solubility in milk, its addition is achieved through an o/w emulsion. The fortified milk can be kept for up to 7 days at refrigerator temperature without any adverse impact on the milk quality. Two servings of the fortified milk can provide almost entire daily requirement of phytosterols.

Conclusion

A quick glance is made over the need of milk fortification by keeping in view the vitamin deficiencies that have occurred due change in lifestyle. Indians need a regular supplement of fortified milk to overcome the effect of deficiencies. Indian government is also active in this field as fortification is cost effective. Keeping in mind milk is fortified with different kind of premix like with aloe vera, iron, phytosterols.

References

1. Abbaspour N., Hurrell R. and Kelishadi R. Review on iron and its importance for human health. Journal of Research in Medical Sciences: The Official Journal of Isfahan University of Medical Sciences 2014;19(2):164–74.
2. Alférez M., and Lopez-Aliaga I. Dietary goat milk improves iron bioavailability in rats with induced ferropenic anaemia in comparison with cow milk. International Dairy Journal 2006;16(7):813–21.
3. Chand P., Pandey N., Naik B., et al. Application of Aloe vera for the development of functional foods. The Pharma Innovation Journal 2019;8(5):621–25.
4. Etcheverry, P., Miller D. D. and Glahn R.P.A low-molecular-weight factor in human milk whey promotes iron uptake by Caco-2 cells. Journal of Nutrition 2004;134(1):93–98.
5. FSSAI. https://www.fssai.gov.in/.../FSSAI_News_Milk_TOI_29_11_2019
6. Gaucheron, F. Iron fortification in dairy industry. Trends in Food Science & Technology, 2000;11(11):403–09. http://doi.org/10.1016/S0924-2244(01)00032-2
7. Gonçalves S., Maria A.V., Silva-Herdade A.S., et al. Milk enriched with phytosterols reduces plasma cholesterol levels in healthy and hypercholesterolemic subjects. Nutrition Research 2007;27(4):200-05.
8. Harinarayan C.V., and Akhila H. Modern India and The Tale of Twin Nutrient Deficiency–Calcium and Vitamin D–Nutrition Trend Data 50 Years-Retrospect, Introspect And Prospect. Frontiers in endocrinology 2019;10:493–95.
9. https://www.fssai.gov.in/.../FSSAI_News_Milk_TOI_06_09_2018
10. https://www.fssai.gov.in/.../FSSAI_News_Milk_Worldbank_03_12_2018
11. Olivares M., Pizarro F., Pineda O., et al. Milk inhibits and ascorbic acid favors ferrous Bis-Glycine chelate bioavailability in humans. Journal of Nutrition 1997;127(7):1407–11.
12. Jiang M., Deng K., Jiang C., Fu M., et al. Evaluation of the antioxidative, antibacterial, and anti-inflammatory effects of the aloe fermentation supernatant containing Lactobacillus plantarum HM218749.1. Mediators of Inflammation 2016;5:26–34.
13. Le Port A., Bernard T., Hidrobo M., et al. Delivery of iron-fortified yoghurt, through a dairy value chain program, increases hemoglobin concentration among children 24 to 59 months old in Northern Senegal: A cluster-randomized control trial. PLoS ONE 2017;12(2): e0172198.
14. Calpe-Berdiel, L., Escola-Gil, J.C. and Blanco-Vaca, F. New Insights into the molecular actions of plant sterols and stanols in cholesterol metabolism. Atherosclerosis. 2009;203;18–31
15. Lengyel J., Rimarčík J., Vagánek A., et al. Oxidation of sterols: Energetics of C–H and O–H bond cleavage. Food chemistry 2012;133(4):1435–40.
16. López-Aliaga I., Díaz-Castro J., Nestares T., et al. Calcium-supplemented goat milk does not interfere with iron absorption in rats with anaemia induced by dietary iron depletion. Food Chemistry 2009;113(3):839–41.
17. Lynch S. R. The impact of iron fortification on nutritional anaemia. Best Practice & Research Clinical Haematology 2005;18(2):333–46.
18. Maurya V.K. and Aggarwal M. Factors influencing the absorption of Vitamin D in GIT: an overview. Journal of Food Science and Technology 2017;54(12):3753–65.
19. McLean E., Cogswell M., Egli I., et al. Worldwide prevalence of anaemia, WHO vitamin and mineral nutrition information system 1993–2005. Public Health Nutrition 2009;12(4):444.
20. Mudgil D., Barak S. and Darji P. Development and characterization of functional cultured buttermilk utilizing Aloe vera juice. Food Bioscience 2016;15:105–09.
21. Nagarajappa V., Battula S.N., Arora S and Naik L.N. Fortification of milk with phytosterol and its effect on sensory and physiochemical properties. Irish Journal of Agricultural and Food research 2018;57(1):63–70.
22. Noakes M., Clifton P. M., Doornbos A. M., et al. Plant sterol ester–enriched milk and yoghurt effectively reduce serum cholesterol in modestly hypercholesterolemic subjects. European Journal of Nutrition 2005;44(4):214–22.
23. Panesar P. S., and Shinde C. Effect of Storage on Syneresis, pH, Lactobacillus acidophilus Count, Bifidobacterium bifidum Count of Aloe vera Fortified Probiotic Yoghurt. Current Research

in Dairy Sciences 2012;4(1):17–23.

24. Pizarro F., Boccio J., Salgueiro M., et al. Bioavailability of stabilised ferrous gluconate with Glycine in fresh cheese matrix: A novel iron compound for food fortification. Biological Trace Element Research 2013;151:441–45.
25. Rajakumar K., Greenspan S.L., Thomas S.B. and Holick M.F. Solar ultraviolet radiation and vitamin D: A historical perspective. American Journal of Public Health 2007;97:1746–54.
26. Sabatier M., Egli I., Hurrell R. et al. Iron bioavailability from fresh cheese fortified with iron-enriched yeast. European Journal of Nutrition 2017;56:1551.
27. Sazawal S., Dhingra U., Dhingra P., et al. Micronutrient fortified milk improves iron status, anemia and growth among children 1–4 years: a double masked, randomized, controlled trial. PLoS ONE. 2010;5:e 12167
28. Smialowska A., Matia-Merino L. and Carr A.J. Oxidative stability of iron for-tified goat and cow milk and their peptide isolates. Food Chemistry 2017;237:1021–24.
29. Soupas L., Huikko L., Lampi A. M. and Piironen V. Oxidative stability of phytosterols in some food applications. European Food Research and Technology 2006;3(4):222–66.
30. Stewart R.J., Smialowska A., Pedley K.C. and Carr A.J. Ascorbic acid-enriched goat milk may be a suitable vehicle for iron fortification. LWT-Food International Journal 2018;97:491–95.
31. Yeh E.B., Barbano D.M. and Drake M. Vitamin fortification of fluid milk. Journal of Food Science 2017;82(4):856–64.