Proceedings of the Nutrition Society (2024), **83 (OCE1)**, E132 doi:10.1017/S0029665124001502

47th Annual Scientific Meeting of the Nutrition Society of Australia and Nutrition Society of New Zealand, 28 November – 1 December 2023, Nutrition & Wellbeing in Oceania

Development of a water-soluble Vitamin D drink for enhanced absorption and serum levels

Z. Liu[1]
[1]*Medicinal Plant Laboratory, School of Renewable Natural Resources, Louisiana State University Agricultural Center, Baton Rouge, LA 70803 USA*

Vitamin D deficiency and insufficiency have been found in general population but especially in women of childbearing age. Although Vitamin D can be obtained from food source (few naturally) and produced from skin sunlight exposure, it can come from a reliable source via supplementation. Supplementing 15 µg daily could meet the recommended dietary allowance for 19 years and older and 20 µg for 70 years older. Daily supplementation greater than 100 µg is not recommended. Unlike water-soluble vitamins B and C, Vitamins A, D, E, and K are fat-soluble. This property of Vitamin D affects not only the delivery of it in drink but also absorption at the small intestine and bioavailability (i.e., serum level). This study focused on enhancing the solubility of vitamin D using a novel botanical solubilizer. Using rubusoside (RUB), isolated from stevia and other plants, Vitamin D_3 (cholecalciferol; VD_3) was experimented for solubility enhancement. VD_3 was processed with RUB to form the VD_3-RUB structure in powder form. Solubility of this powder in physiologic solutions of water, gastric or intestinal fluid, stability over time, and dilutability for achieving desired supplementation levels were examined. The VD_3-RUB complex structure in water solution was characterised for particle size and shape using dynamic light scattering techniques. VD_3 in water solution after filtration was quantified on HPLC. VD_3 was practically insoluble in water. However, in the presence of 10% w/v RUB as the botanical solubilizer, VD_3 became soluble in water to a concentration of 4,500 µg/mL. This water-soluble concentrate appeared clear and was freely dilutable to a drink containing amounts of VD_3 ranging from 15 µg to 100 µg. Particle size analysis indicated the presence of approximately 4 nm spherical particles. HPLC analysis of the water solution detected RUB and VD_3. These drinks were stable and remained clear and transparent for at least eight weeks. A packet of water-soluble Vitamin D_3 powder was also developed for addition to a glass of water in the amount of 15 µg VD_3. The packet, similar to the instant coffee powder, produced an instant Vitamin D drink containing the recommended dietary allowance of 15 µg. The water-soluble VD_3 powder was also dissolvable in simulated gastric fluid and intestinal fluid, and stable for at least two hours. This solubility enhancement could aid in absorption and improve oral bioavailability, seen in the work with oily ceramides[(1)] and insoluble curcumin[(2)]. It is especially advantageous for making drinks as the solubilizer is generally regarded as safe by the US FDA.

Keywords: solubility enhancement; delivery of nutritional ingredients; natural solubilizers; Vitamin D

Ethics Declaration

Yes

Financial Support

This research received no external funding.

References

1. Chen J, Khiste S, Fu X *et al.* (2020) *Prostaglandins Other Lipid Mediat* **146**, 106402.
2. Zhang F, Koh G, Jeansonne D *et al.* (2011) *J Pharm Sci* **100**, 2778–2789.