



Optimization of Vitamin D Enrichment in Yoghurt

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ABSTRACT

Yoghurt is a favourite dairy product for billions of people around the world and the producers constantly seek out ways of bringing new varieties for new eating occasions to be enjoyed anywhere and anytime. An attempt was made to enrich the vitamin D₃ in yoghurt. The crystalline vitamin D₃ was enriched at three different levels viz., 1000 IU, 1500 IU and 2000 IU in one litre of milk. The vitamin D₃ enriched yoghurt samples were subjected to sensory evaluation for its acceptance, using the 9-point hedonic scale. There was no significant difference observed in acidity and overall acceptability. It was concluded that the yoghurt enriched with vitamin D₃ @1500 IU in one litre of milk revealed better sensory acceptability during storage up to 14 days at 5°C. The daily requirement of vitamin D is 400 IU. Hence, by consuming 100 ml of yoghurt enriched with vitamin D₃ at 1500 IU in one litre of milk, about 10 per cent of the vitamin D daily requirement can be fulfilled.

Key Words: Acceptability, Sensory evaluation, Vitamin D enrichment, Yoghurt.

INTRODUCTION

Vitamin D plays an important role in maintaining a healthy mineralized skeletal system for most land vertebrates including humans. Animals and humans get vitamin D through food and by exposure to sunlight. Exposure to sunlight leads the photo production of vitamin D, in the skin. Once synthesized, vitamin D₃ is metabolized sequentially in the liver and kidney of the human and animal body to 1, 25-dihydroxyvitamin D. The biological function of 1, 25-dihydroxyvitamin D is to maintain the serum calcium and phosphorus concentrations within the normal range to sustain essential cellular functions and to promote mineralization of the skeleton (Holick, 1996).

Vitamin D insufficiency and vitamin D deficiency is now being recognized as a major cause of metabolic bone disease in the elderly. Vitamin D deficiency not only causes osteomalacia but can exacerbate osteoporosis. Arora *et al* (2014) reported that food fortification is thought to be a highly effective solution and among the most cost-effective public health interventions currently

available. Thus present study was conducted to enrich vitamin D in yoghurt which is relished by all age groups.

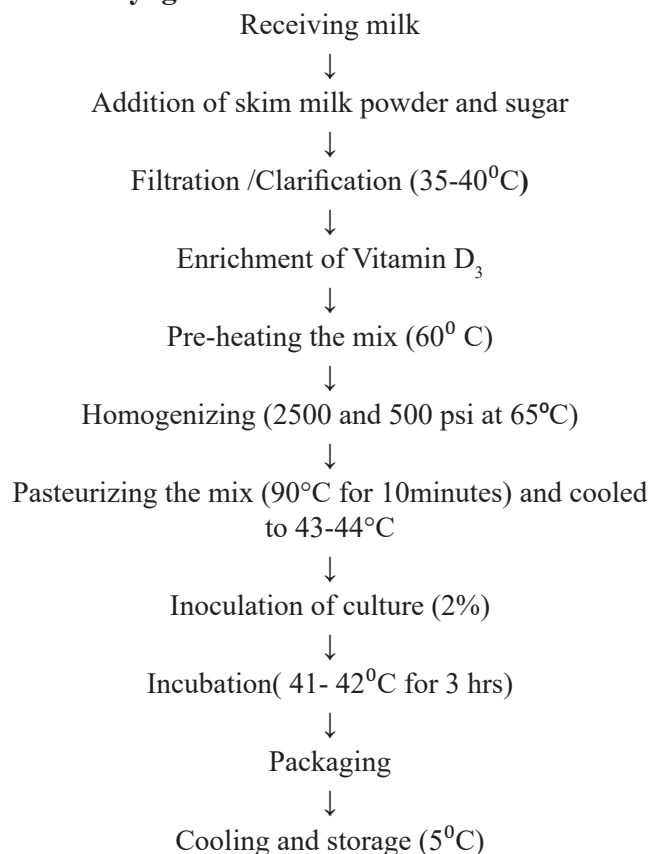
MATERIALS AND METHODS

Milk was procured from Livestock Farm Complex, Veterinary College and Research Institute, Orathanadu. Skim milk powder testing 5% moisture and 95% solubility was purchased from Tamil Nadu Co-operative Milk Producers' Federation (Aavin) and used to standardize the milk solids not fat content of yoghurt. Crystalline vitamin D₃ was procured from Sigma Aldrich (Saint Louis, MO, USA). Crystalline vitamin D₃ was added at three different levels viz., 1000 IU, 1500 IU and 2000 IU in one litre of milk. The milk was heated to 65°C and homogenized at 2500 and 500 PSI in a two stage homogenizer. Commercially available good quality cane sugar was used in the preparation of yoghurt. Freeze dried DVS culture containing yoghurt bacteria *Lactobacillus delbrueckii ssp. bulgaricus* and *Streptococcus salivarius ssp. thermophilus* (YC-X11) obtained from Chr. Hansen,

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Denmark was used. The guidelines prescribed by IS: 12898(1989) and the flow chart indicated by De (1980) were followed in the preparation of yoghurt.

Flow chart for the preparation of vitamin D enriched yoghurt



The vitamin D₃ enriched yoghurt samples were evaluated by a semi trained panel of seven judges for the attributes of flavour, body and texture, colour and package, acidity and overall acceptability scores on a 9-point hedonic scale (Tomic *et al*, 2017). All the statistical analyses were performed by using SPSS. The results were expressed as the mean $\pm$ S.E., and in all applications (ANOVA) the differences were considered statistically significant at $P < 0.05$ and highly significant at $P < 0.01$.

RESULTS AND DISCUSSION

The developed vitamin D₃ enriched yoghurt was assessed by sensory evaluation using the 9-point hedonic scale by a semi-trained panel of seven members (Table 1).

Statistical analysis revealed that there was significant difference ($p < 0.05$) in flavour, body and texture and overall acceptability scores between control and treatments. There was no significant difference observed in acidity and overall acceptability. The fortified yoghurt samples with crystalline vitamin D₃ up to 1500 IU per litre of milk had better acceptability than 2000 IU per litre. Hence the yoghurt enriched with crystalline vitamin D₃ at the concentration of 1500 IU per litre of milk (T2) was selected for further studies.

Table 1. Optimizing the enrichment levels of crystalline vitamin D₃ in yoghurt by sensory evaluation using 9-point hedonic scale.

Attribute	Control	T1	T2	T3
Flavour	8.62 $\pm$ 0.08 ^b	8.50 $\pm$ 0.08 ^b	8.55 $\pm$ 0.08 ^b	7.41 $\pm$ 0.10 ^a
Body & texture	8.52 $\pm$ 0.09 ^c	8.36 $\pm$ 0.10 ^{bc}	8.10 $\pm$ 0.06 ^b	7.29 $\pm$ 0.12 ^a
Colour & Package	8.07 $\pm$ 0.11	8.50 $\pm$ 0.10	8.07 $\pm$ 0.11	8.00 $\pm$ 0.10
Acidity	8.38 $\pm$ 0.10	8.50 $\pm$ 0.11	8.36 $\pm$ 0.11	8.21 $\pm$ 0.12
Overall acceptability	8.60 $\pm$ 0.09 ^c	8.38 $\pm$ 0.09 ^c	8.14 $\pm$ 0.09 ^b	7.45 $\pm$ 0.09 ^a

Mean $\pm$ SE with different superscripts in a row differ significantly ($P < 0.05$).

C- Control (unfortified)

T1 - Treatment with 1000 IU/L Crystalline vitamin D₃

T2 - Treatment with 1500 IU/L Crystalline vitamin D₃

T3 - Treatment with 2000 IU/L Crystalline vitamin D₃

n = 42 for each treatment

Sensory scores based on 9-point hedonic scale, where 1: dislike extremely and 9: like extremely

Optimization of Vitamin D Enrichment in Yoghurt

ANOVA for optimizing the enrichment levels of crystalline vitamin D₃ in yoghurt by sensory evaluation

Attributes	Source of variation				
	Treatment			Error	
	d.f.	MSS	F value	d.f.	MSS
Flavour	3	11.022	33.341**	164	0.331
Body & texture	3	12.349	30.642**	164	0.403
Colour & Package	3	0.054	0.125	164	0.429
Acidity	3	0.329	0.724	164	0.447
Overall acceptability	3	11.149	35.275**	164	0.316

** Highly significant (P<0.01)

CONCLUSION

Vitamin D deficiency with its multifarious effects on health status, levies a huge burden on the healthcare system worldwide. Several advanced nations have launched nationwide fortification programs to improve vitamin D status. India must follow suit. Foods are rarely fortified with vitamin D in India. Hence an attempt has been made to enrich vitamin D₃ in yoghurt at 1500IU per litre of mix which evinced better overall sensory acceptability in the finished product. It was concluded that the yoghurt enriched with vitamin D₃ @1500 IU in one litre of milk revealed better sensory acceptability during storage up to 14 days at 5°C. The daily requirement of vitamin D is 400 IU. Hence, by consuming 100 ml of yoghurt enriched with vitamin D₃ at 1500 IU in one litre of milk, about 10 per cent of the vitamin D daily requirement can be fulfilled.

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