Bioavailability of Vitamin D from Bread Made with High Vitamin D Yeast in Rats

E. Hohman1, B. Martin1, P. Lachcki1, D.T. Gordon2, J. Fleet1, C.M. Weaver1  
1Purdue University, W. Lafayette, IN, 2 North Dakota State University, Fargo, ND

ABSTRACT

Food fortification may be a practical way to provide supplemental vitamin D (VD), especially for populations with limited sun exposure. However, VD fortified foods are limited and bioavailability of VD from such foods is unknown. Foods can be fortified with vitamin D3 (D3) or vitamin D2 (D2), but some reports have shown that D2 may be less effective than D3 at maintaining VD status. We evaluated the ability of bread made with high VD2 yeast to raise VD metabolic levels in plasma of VD deficient, growing rats. Four-week-old male Sprague Dawley rats were housed in a room without UVB light exposure. They were fed a VD deficient diet containing 25 IU crystalline D3/kg diet for 8 weeks to establish VD deficiency. Rats were randomized to diets containing crystalline D3 or high D2 yeast baked into bread, at one of four target concentrations (25 IU, 100 IU, 200 IU, or 1000 IU/kg) for 8 weeks (n=10/group). Plasma 25-hydroxyvitamin D (25OHD) level was measured by RIA. Within source group, differences between doses were analyzed by one-way ANOVA and Tukey’s test (p<0.05). The dose-response relationship between vitamin D intake and plasma 25OHD was modeled by linear regression. Rats fed D3 or high D2 yeast baked into bread increased their plasma 25OHD in a dose-dependent, linear manner. There was no difference in the rate of increase in 25OHD per IU of VD in the diet between the two VD sources. In summary, this study suggests that high D2 yeast baked into bread is bioavailable and as effective as D3.

BACKGROUND

• Optimal vitamin D status is important for bone health and may also play a role in risk for a number of chronic diseases  
• Cutaneous production of vitamin D3 may be insufficient to meet the needs of populations with limited sun exposure. In these populations, a good source of dietary vitamin D is essential.  
• Few foods are naturally rich in vitamin D (mainly oily fish)  
• Some vitamin D fortified foods exist (milk, juice, cereals), but they are limited and often inconsistent in their vitamin D content  
• Bioavailability of vitamin D from fortified and natural products is generally unknown  
• Bread is a widely consumed staple food, and is therefore an ideal target for fortification  
• Bread fortified with VD has been shown to increase plasma 25OHD effectively  
  - Vitamin D exists in two forms: vitamin D3 and vitamin D2. Some reports indicate D2 may be less potent than D3, while others indicate that the two forms are equivalent.  
  - Yeast produces high amounts of VD2 when exposed to UV light, making it a naturally rich source of VD

OBJECTIVE

The objective of this study was to determine the dose response of bread made with high VD2 yeast compared with crystalline VD3 on VD metabolites in plasma of VD deficient rats.

METHODS

Animals

Four week old male Sprague Dawley rats (Harlan) were housed in a room without exposure to UVB light. They were fed a VD deficient diet based on the AIN 93G formulation containing 25 IU crystalline vitamin D3/kg feed (Research Diets) and water ad libitum for 7 weeks. Body weight and food intake were monitored weekly. After 7 weeks, 5 rats were sacrificed with overdose of CO2 and blood was collected to confirm vitamin D deficiency. The remaining rats were randomized to one of 8 diets (n=10/group), containing 25, 100, 200, or 1000 IU/kg of either crystalline D3 or high D2 yeast (Lallemand Vitamin D baked yeast) baked into bread. The respective diets and water were fed ad libitum for 8 weeks. After 4 weeks on the experimental diets, blood was drawn from the saphenous vein from 8 rats in each group. At the end of 8 weeks, rats were sacrificed by CO2 overdose. Blood was collected via the dorsal aorta and placed in sodium heparin vacutainers.

Diet

The vitamin D contents of the diets were analyzed by HPLC.

Vitamin D Status

Plasma 25OHD status was measured at 4 and 8 weeks by radioimmunoassay (IDEXX). Values for plasma from rats at D3 containing diets were multiplied by a correction factor of 0.9 to account for the reduced reactivity of the RIA with D3 described in the kit’s instructions.

Statistical Analysis

Data were analyzed using SAS (Version 9.1). Differences within source groups were assessed by Tukey’s test. Dose-response relationship was determined using linear regression. A paired t-test was used to compare 4 and 8 week plasma 25OHD status. Significance was accepted at p<0.05.

RESULTS

Tables 1 and 2. Plasma 25OHD at 8 weeks

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Target Vitamin D Level (IU/kg)</th>
<th>Analyzed Vitamin D Content Plasma 25OHD (nmol/L)</th>
<th>P value</th>
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<tbody>
<tr>
<td>0 25OHD</td>
<td>0</td>
<td>0</td>
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<tr>
<th>Table 2</th>
<th>Target Vitamin D Level (IU/kg)</th>
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CONCLUSIONS

Vitamin D from bread made with high D2 yeast is bioavailable and increases vitamin D status (plasma 25OHD) in a dose-dependent manner similar to crystalline vitamin D3.

REFERENCES


ACKNOWLEDGEMENTS

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[Image: Purdue University, W. Lafayette, IN, 2 North Dakota State University, Fargo, ND]