Influence of Dietary Fiber (Konjac Mannan) on Absorption of Vitamin B12 and Vitamin E

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DOI, K., MATSUURA, M., KAWARA, A., TANAKA, T. and BABA, S. Influence of Dietary Fiber (Konjac Mannan) on Absorption of Vitamin B12 and Vitamin E. Tohoku J. exp. Med., 1983, 141, Suppl., 677-681—The subjects of this study were six normal and five maturity onset diabetics. On the first day of the study, subjects were given a control test meal, prepared by adding vitamin B12 3000r (mecobalamin) and vitamin E 500 mg (tocopherol acetate), after a 12-hr overnight fast. Then, on the second day in the case of the normal subjects, and on the seventh day in the case of the diabetic subjects, the subjects received a second test meal with 3.9 g konjac mannan (glucomannan). Venous blood samples were taken immediately before the test meal and again after 1, 3, 5, 8, 12 and 24 hr for analysis of vitamins. The absorption rate of vitamin E into the intestine was reduced when konjac mannan was added to the test meals, but that of vitamin B12 was not reduced in normal or diabetic subjects. It is suggested that konjac mannan reduces fat-soluble vitamin absorption removing bile acids, but does not reduce fat-insoluble vitamin absorption in the intestine.

It has been suggested that high-fiber diets may be beneficial for diabetics since they reduce the postprandial blood glucose1-5) and serum lipid levels6,7), but the exact mechanisms of their actions have not yet been clarified. It is considered, however, that dietary fibers increase the viscosity of the gastrointestinal contents thereby retarding gastric emptying2,8) and delaying absorption by the intestinal wall. Therefore, their viscosity appears to be a major factor in suppressing the postprandial rise in the blood glucose level2,5). The highly viscous fibers such as glucomannan, guar gum and pectin that appear to have the greatest effect on blood glucose are of similar importance in lipid metabolism. The serum levels of cholesterol and bile acids decreased when the mucilaginous fibers were used. One possible explanation for this phenomenon is that the enterohepatic circulation of bile acids and cholesterol is interrupted by their absorption in the
It is generally accepted that the absorption of fat soluble vitamins is dependent on the presence of a micellar phase and of conjugated bile acids in the intestinal lumen. The present study was conducted to reassess whether konjac mannan (glucomannan) adsorbs conjugated bile acids in vivo by observing its effect on vitamin B12 and vitamin E absorption, as measured by the vitamin B12 and vitamin E tolerance test.

**MATERIALS AND METHODS**

Six normal volunteers, aged 20-61 years and five maturity onset diabetic patients, aged 57-81 years were studied. On the first day, subjects received a control test meal after a 12-hour overnight fast and on the second day in normal subjects and seventh day in the diabetics subjects received a second test meal with 3.9 g konjac mannan (Shimizu Chemical Industries, Co. Ltd.). The test meal was prepared by adding vitamin B12 3000 r (mecobalamin; Eisai) and E 500 mg (tocopherol acetate; Eisai). All subjects were allowed a certain amount of lunch and evening meals.

Venous blood samples were taken immediately before the test meal and again after 1, 3, 5, 8, 12 and 24 hr for analysis of vitamins.

Serum levels of vitamin B12 were determined by radioimmunoassay and vitamin E was determined by the fluorometric method. The results were expressed as mean plus or minus standard error, and the significance was calculated by the Student's t-test for paired data.

**RESULTS**

In most normal subjects given a control test meal, the peak serum vitamin B12 level was observed at 3 hr, and in the case of the diabetic subjects, 5 to 8 hr

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![Fig. 1. Influence of konjac mannan on intestinal absorption of vitamin B12 in normal subjects.](image-url)
after ingestion of the meal (Figs. 1, 2). When konjac mannan was added to the test meal, the timing of the peak serum vitamin B12 level in normal subjects was shifted from 3 to 12 hr, but in diabetic subjects was not changed. The maximum rate of increase of vitamin B12 in serum was 19.6±9.2% in normal and 68.6±24.9% in diabetic subjects. These results indicate that absorption of vitamin B12 in

Fig. 2. Influence of konjac mannan on intestinal absorption of vitamin B12 in diabetic subjects.

Fig. 3. Influence of konjac mannan on intestinal absorption of vitamin E in normal subjects.
intestine is not disturbed by konjac mannan and that the absorption rate of vitamin B12 diabetic subjects is much higher than in normal subjects.

On the other hand, when konjac mannan was added to the test meals, the serum levels of vitamin E in normal subjects were significantly reduced at 1 hr (17.8±8.7% vs. -4.3±2.7% ; p <0.0125), 3 hr (15.6±4.8% vs. -0.1±4.7% ; p <0.025), 8 hr (47.1±11.5% vs. 17.8±4.8% ; p <0.0125) and 12 hr (49.8±14.2% vs. 20.4±8.2% ; p <0.05) respectively (Fig. 3). The peak serum vitamin E levels were reduced in all diabetic subjects except one (Fig. 4). No great difference in the absorption rate of vitamin E in the intestine was observed between normal and diabetic subjects.

![Graph showing the influence of konjac mannan on the absorption of vitamin E in diabetic subjects.](image)

**DISCUSSION**

We have studied the treatment of diabetics with konjac mannan\(^4,5\). Like guar gum\(^1,2\), konjac mannan has proved useful in the treatment of diabetics, since it reduces the postprandial blood glucose and serum lipid levels. These fibers are considered to increase the viscosity of the gastrointestinal contents, slowing emptying and forming a barrier\(^12\) around the food which delays its absorption by the intestinal wall.

It is believed that viscous forms of dietary fiber prolong the time required for absorption rather than causing malabsorption\(^2\). A xylose absorption test was performed to check for malabsorption\(^2,5\). A significant decrease in 2-hr urinary xylose excretion was observed with konjac mannan. However, the total excretion of xylose was the same in both control and konjac mannan subjects, when urine
collection was continued for 6 hr.

Serum Cu++, Fe++, Na+, K+ and Cl− levels in diabetics were followed for 4 months, but no significant increase or decrease was observed5).

On the other hand, the serum levels of cholesterol and bile acids decreased when konjac mannan was used. The theory that various types of fibers bind bile acids was tested. In this study, we showed that konjac mannan impairs the absorption of vitamin E, but not of vitamin B12, because the absorption of fat-soluble vitamin is dependent on the presence of conjugated bile acids.

The absorption rate of vitamin B12 in diabetic subjects was much higher than in normal subjects. The reason for this is not clear. The only differences between the two groups were age and blood glucose levels.

In this study, we showed that konjac mannan markedly reduces vitamin E absorption as assessed by the vitamin E tolerance test, removing bile acids. Care should be taken in the use of these dietary fibers for diet treatment.

References