Effect of Vitamin C on Glycosylation of Proteins

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Twelve nondiabetic subjects consumed 1 g/day vitamin C for 3 mo. A fasting blood sample was taken at the start of the study and at the end of each month for the measurement of plasma and intramyocyte glucose, vitamin C, glycylated hemoglobin (affinity chromatography and electrophoresis), and glycylated albumin (affinity chromatography). Although there were no significant changes in fasting glycemia, glycylated hemoglobin (affinity chromatography) decreased 18%, from 6.18 ± 0.48% (mean ± SD) at the start to 5.06 ± 0.50% (P < 0.0001) after 3 mo, whereas, HbA1c measured by electrophoresis increased 15%, from 6.17 ± 0.53 to 7.16 ± 0.59% (P < 0.0001) in this period. Glycylated albumin decreased 33%, from 1.56 ± 0.24 to 1.04 ± 1.01% (P < 0.0001) after 3 mo. This discrepancy between glycylated hemoglobin measured by electrophoresis and affinity chromatography was due to methodological differences between the two techniques, with affinity chromatography measuring "true" glycylated hemoglobin. The greater decrease found with glycylated albumin was probably due to the different distribution of vitamin C between plasma and within the erythrocyte levels at 1 mo of supplementation being 109 ± 19 and 59 ± 9 μM, respectively (P < 0.001). This indicates that administration of oral vitamin C may inhibit the glycosylation of proteins in vivo by a competitive mechanism. Diabetes 41:167–73, 1992

Vitamin C, in particular dehydroascorbic acid, has long been known to food chemists to react with amino groups of both amino acids and proteins (1–3). Studies with electron-spin resonance showed that ascorbic acid could bind to proteins via an ionic interaction (4). In physiological fluids, it is likely that dehydroascorbic acid can form a reversible Schiff base with amino groups (5). It is also possible that with amino groups to form Schiff bases (Fig. 1). The three compounds, (ascorbic acid, dehydroascorbic acid, and diketogulonic acid) could compete with case for binding to proteins and thereby inhibit glycosylation.

Several studies have shown that vitamin C and glycylated proteins (6,7). However, the effect found were confusing and conflicting. In preliminary work, Stoibka et al. (6,8) investigated the effect of ascorbic acid and its metabolite dehydroascorbic acid on glycylated bovine serum albumin and collagen in the presence of varying concentrations of glucose. They found that, although ascorbic acid inhibited glycosylation, dehydroascorbic acid apparently enhanced glycosylation. Khatami et al. (7) also studied the effects of ascorbic acid and dehydroascorbic acid on the glycylation of bovine serum albumin in vitro but found that both compounds inhibited glycosylation. The difference between the two studies in the concentration of vitamin C used. Stoibka et al. (6) used concentrations up to 1 mM, whereas, Khatami et al. used 5 mM ascorbic acid and dehydroascorbic acid. Stoibka et al. also performed an in vivo study in which the diet of 10 independent diabetic subjects was supplemented with 1 g/day vitamin C for 3 wk. A significant fall in fructosamine concentration occurred, thus suggesting inhibition of glycosylation of plasma proteins by vitamin C but no change in glycermia was observed.

Although Stoibka et al. (6) showed a significant decrease in fructosamine concentration in vivo with vitamin C supplementation, the effect of glycosylation of proteins in vivo by a competitive mechanism. Diabetes 41:167–73, 1992

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