

Diabetes and Antioxidants Tomato Lycopene

Diabetes mellitus is a metabolic disorder characterized by abnormal glucose tolerance and or a decreased insulin sensitivity. The long term effects of diabetes include retinopathy with potential loss of vision, nephropathy leading to kidney failure, risk of foot ulcers, amputation, and gastrointestinal, genitourinary, and cardiovascular symptoms. Diabetes is the seventh leading cause of death and affects 15.7 million or 5.9% of the American population.

There are two major types of diabetes. Type I, insulin dependant diabetes mellitus (IDDM) and Type II, non-insulin dependant diabetes mellitus (NIDDM). Type I is considered an autoimmune disease in which the insulin-producing beta cells in the pancreas are destroyed. The result is either inadequate or no insulin production. Individuals with Type I diabetes require daily insulin injections for normal functioning of the body. Type I diabetes accounts for approximately 5 to 10 percent of diagnosed cases in the United States. It develops more often in children and young adults, but the disorder can appear at any age. Symptoms include frequent thirst and urination, constant hunger, weight loss, blurred vision, and extreme tiredness. If the individual is not diagnosed and treated with insulin, he or she could lapse into a life-threatening coma.

Type II diabetes is the more common form of the disease accounting for 90 to 95 % of all cases. This form of diabetes usually develops in later life and is often associated with obesity and overweight. In most cases the pancreas will produce insulin, but for some reason, the body cannot utilize the insulin effectively. The result is a buildup of glucose in the blood. The symptoms of Type II diabetes develop gradually and are not as obvious as Type I. Symptoms include hypertension, fatigue, frequent urination (especially at night), unusual thirst, weight loss, blurred vision, frequent infections, and slow healing of sores (1,2).

Reactive oxygen species (ROS) have been implicated in playing a major role in the causation and progression of several chronic diseases including cancer and cardiovascular disease (3). These ROS are highly reactive molecules that combine with substances in the body, such as cells, altering them in a harmful way, thus potentiating the disease. Consumption of carotenoid rich food has been associated with several health benefits including their ability to protect against oxidative damage (4). Lycopene, a carotenoid antioxidant found in tomatoes, has shown to be an effective antioxidant. This means it has the ability to prevent free radical damage to cells caused by ROS (3).

Recent studies have found free radicals to cause disruption in insulin action and mitigate glucose-intolerant states (5). Because lycopene is one of the best antioxidants among carotenoids, as evidenced by its singlet oxygen-quenching ability, it may play a vital role in reducing the on-set of this disease (5). However, very little information is known about the association between lycopene and other carotenoids and glucose intolerant states.

Olemedilla et al (6) studied the fat soluble antioxidant status in IDDM patients. Using 450 controls and 123 Type I diabetic patients, the team examined and compared concentrations of serum retinol, tocopherol, and main carotenoids. Lycopene and β -carotene were the only nutrients positively associated with the disease, while retinol was the only nutrient that indicated a significant negative association with diabetes.

Conflicting results were reported by Granado et al (7) comparing the antioxidant status of 54 Type I diabetic patients, 214 non-diabetic first degree relatives and 236 unrelated controls. The study found no significant differences in serum vitamin E, lutein, or lycopene

between controls and patients with IDDM. In fact the investigators observed serum fat-soluble antioxidant levels equal to or higher than those in controls, and concluded that supplementation with fat-soluble antioxidants is not necessary for patients with diabetes.

Ford et al. (5) recently analyzed the data from Phase I of the Third National and Nutrition Examination Survey (1988-1991) to examine carotenoids concentration in 40 to 70 year old subjects with normal glucose tolerance (1010 subjects), impaired glucose tolerance (277 subjects) and newly diagnosed diabetic cases (148 subjects). All serum carotenoids were found to be inversely associated with the fasting serum insulin levels. Moreover, serum lycopene and β -carotene levels in the diabetic patients were significantly lower compared to levels in persons with impaired glucose tolerance and was also found to be lower than the levels in subjects with normal glucose tolerance (5).

Diabetic Asian Indian physicians living in USA were found to have lower lycopene compared to their non-diabetic counterparts (8). Similarly elderly subjects with Type II diabetes were reported to have significantly lower levels of plasma antioxidants including lycopene, compared to matched controls (9). In a clinical trial (10), tomato juice supplementation in Type II diabetic patients resulted in nearly 3 fold increase plasma levels of lycopene and significant protection from LDL oxidation, a risk factor in CVD (8).

Raw and processed tomato products are excellent sources of dietary lycopene. Lycopene has been associated with a decreased risk in cancer and cardiovascular disease. The antioxidant properties of lycopene are thought to be primarily responsible for these beneficial effects (3,4). Recent evidence suggests that glucose-intolerant states are a result of increased oxidative stress, and that lycopene may play a role in reducing the pathogenesis of diabetes through its antioxidant capacity (5). However, this hypothesis needs to be clinically examined.

References

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