## Letter to the Editor

# Protective Effects of Lycopene on Furan-treated Diabetic and Non-diabetic Rat Lung

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**We assessed the effects of furan and lycopene on the histopathological and biochemical changes on lungs, body and lung weights, and food consumption of rats. Furan and diabetes caused histopathological changes, increment in malondialdehyde levels, and decrease in antioxidant enzyme activities. Lycopene showed a protective effect against these damages, except for glutathione-S-transferase and glutathione peroxidase activities. Consequently, furan and diabetes resulted in lung toxicity. Our findings demonstrate that furan treatment resulted in more alterations in histology and biochemical parameters in diabetic rats and lycopene showed protective effects against these alterations.**

Furan occurs in various processed foods. It is important to determine the harmful effects of furan, as it is known to affect both animals and humans[1]. It causes toxicological effects on the reproductive system in male rats[2].

Cells can reduce the pro-oxidative state through antioxidants. When exposed to toxicants, changes in the antioxidant enzyme activities occur. Hence, activities of these enzymes have been used to evaluate oxidative stress in the cells. Several chemicals may damage the cell membranes by inducing lipid peroxidation (LPO). Malondialdehyde (MDA) is an end product of LPO resulting from the interaction between ROS and cellular membranes[2-3].

Lycopene is a dietary carotenoid found in fruits. Recent studies have shown that lycopene is inversely associated with the risk of cancers and heart disease. Accumulated experimental evidence suggests that lycopene can inhibit oxidative damage in cell membranes[4]. In recent years, lycopene has been one of the most studied materials for its antioxidant property.

Diabetes is a major worldwide problem and a chronic metabolic disorder, with an incidence of 2.5%-3% in the world population. Therefore, in this study, we also used diabetic rats to determine the effects of furan and lycopene in diabetic individuals. Several reports have suggested the pathophysiological mechanisms of diabetes[5]. However, there are no sufficient data regarding pulmonary disease in diabetic patients.

The aims of this study were to determine the effect of furan on the lungs of diabetic and non-diabetic male rats and to assess whether these effects can be ameliorated by lycopene. We focused on the lungs because, although several studies have analyzed other tissues such as the liver and kidney in diabetes, data regarding the effects on lungs are scarce.

Male Wistar rats (300-320 g) were handled in accordance with the standard guide for the care and use of laboratory animals. The protocol was approved by the Çukurova University Animal Experiments Local Ethics Committee.

Furan (40 mg/kg body weight) and lycopene (4 mg/kg body weight) were dissolved in corn oil[1,4]. These doses were selected according to previous studies[1,4]. The animals were divided into eight groups (seven rats in each group): control, lycopene-treated, furan-treated, furan+lycopene-treated, diabetic control, diabetic lycopene-treated, diabetic furan-treated, and diabetic furan+lycopene-treated groups. After 28 d, the rats were sacrificed and dissected, and the lungs were isolated. Samples were stored at -80 °C until the analysis. Diabetes was induced by STZ injection. Rats with ≥300 mg/dL of glucose were selected for the diabetic group[5]. The body and lung weights and food consumptions of rats were measured by an automatic balance.

The MDA levels and superoxide dismutase (SOD), catalase (CAT), glutathione-S-transferase (GST), and glutathione peroxidase (GPx) activities were determined with a spectrophotometer, following the methods that were used in the study by Baş and Kalende[6].

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Tissues were fixed in formalin and then processed using a graded ethanol series. They were embedded in paraffin, cut (6-7 μm), and stained with hematoxylin and eosin (H&E). The sections were evaluated with a light microscope.

Data were analyzed using SPSS 20.0 for Windows. The experimental groups were compared using analysis of variance and Tukey's test. $P<0.05$ was considered statistically significant. The results are expressed as mean±standard error of the mean (SEM).

Body weights, lung weights, and food consumption did not show significant changes between the non-diabetic groups and also between the diabetic groups. When the diabetic and non-diabetic groups were compared, increases in lung weights and food consumption and decreases in body weights in diabetic rats were observed (Figure 1).

The enzyme activities and MDA levels were similar in both the control and lycopene groups. In the furan-treated group, there were decreases in the enzyme activities (GST 27.59%, CAT 31.99%, GPx 32.51%, and SOD 41.55%) and increases in the MDA levels (68.75%). When the furan group and the furan+lycopene group were compared, decreases in the MDA levels (14.41%) and increases in SOD (26.82%), CAT (10.95%), GPx (13.47%), and GST (21.43%) activities were observed.

A comparison of the diabetic control group with the non-diabetic control group revealed higher MDA levels (50%) and lower enzyme activities (GST 15.52%, CAT 25%, GPx 22.65%, and SOD 26.64%). When we compared the diabetic control group with the diabetic lycopene group, the protective effects of lycopene were observed, except for GPx and GST activities. There were significant decreases in MDA levels (18.75%) and increases in SOD (17.43%) and CAT (15.86%) activities in the lycopene group. Furan treatment caused increases in the MDA levels (27%) and decreases in the enzyme activities (GST 32.65%, CAT 24.46%, GPx 34.86%, and SOD 31.33%) and lycopene showed protective effects against these damages. When the diabetic furan group and the diabetic furan+lycopene group were compared, significant decreases in the MDA levels (14.75%) and increases in SOD (16.62%), CAT (19.57%), GPx (33.03%), and GST (21.21%) activities were observed (Figure 2).

Normal lung alveoli structures were observed in the control (Figure 3A) and lycopene groups (Figure 3B). In the furan group, we detected emphysematous changes, thickened and increased connective

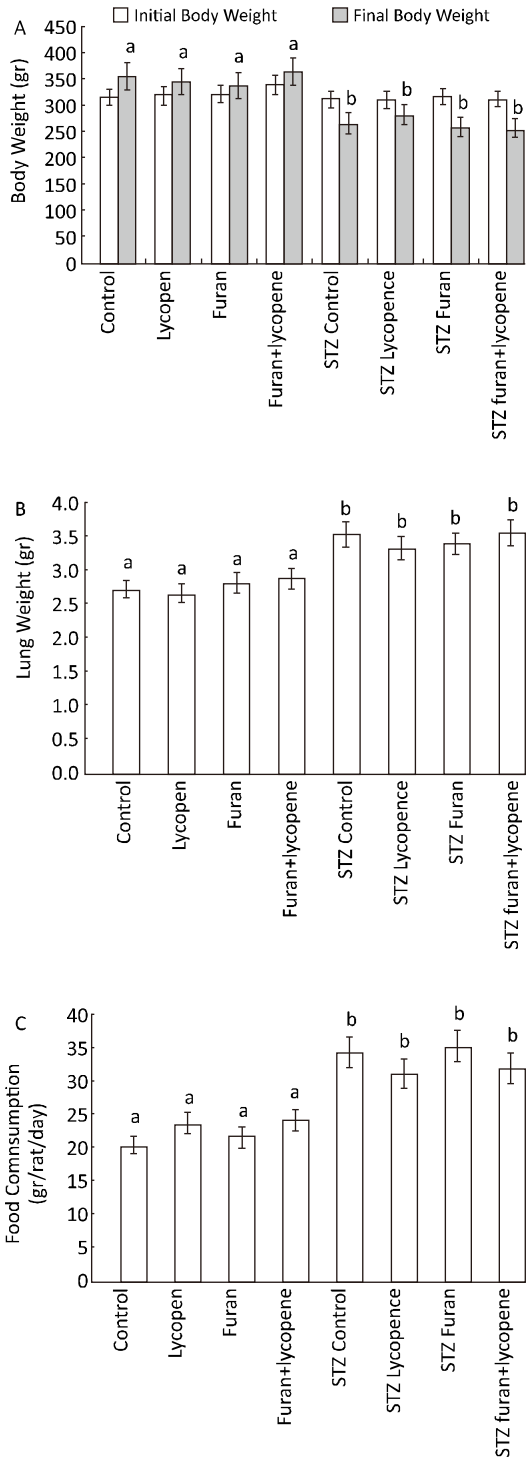


**Figure 1.** Effects of furan and lycopene on body weights (A), lung weights (B), and food consumption (C). Column superscripts with different letters represent significantly different values. Data represent the mean±SEM of seven samples. Significance at $P<0.05$.