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Aorta and Liver Changes in Rats Fed Cholesterol-Containing and Raw Vegetable-Supplemented Diets: Experiments in Vitro and in Vivo

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ABSTRACT: The aim of this investigation was to compare the liver and aorta changes in rats fed cholesterol-containing diets and the possible improvement when diets would be supplemented with frequently used raw vegetables. The phenolic compounds of three vegetables in methanol—water (1:1) fraction were characterized using electrospray ionization mass spectra (ESI-MS). Results showed that the content of polyphenols, flavonoids, quercetin, flavanols, tannins, and ascorbic acid varied for garlic and white and red onions ranging from 6.68 to 18.08 mg GAE/g DW, 490.4–701.0 µg CE/g DW, 281.2–1100.0 µg, 32.40–41.30 µg CE/g DW, 2.88–3.12 mg CE/g DW, 1.87–2.33 mg AA/g DW, 1388.2–1442.3 µg CGE/g DW, respectively. The radical scavenging capacities (µM TE/g DW) for the same investigated vegetables for ABTS, FRAP, CUPRAC, and DPPH assays ranged from 48.78 to 92.42, 9.41–28.56, 3.06–10.41, and 6.49–23.42, respectively. Good correlations were observed between the phenolic contents and the radical scavenging capacities of the vegetables. The interaction between BSA and quercetin, BSA and garlic and onions extracts was measured by 3-dimensional fluorescence (3D-FL) and Fourier transform infrared (FT-IR) spectroscopy. The highest polyphenol content was found in methanol/water fraction of onions and garlic; therefore, for the investigation of in vitro interactions with BSA only polyphenols of this fraction were used. For in vivo studies, 30 male Wistar rats were divided into 5 groups each of 6 and named Control, Chol, Chol/Garlic, Chol/OnionRed, and Chol/OnionWhite. During 6 weeks, the rats of all 5 groups were fed a basal diet (BD). The rats of the Control group were fed the BD only. The BD of the Chol group was supplemented with 10 g/kg of nonoxidized cholesterol (NOC). Each of the other three groups was supplemented with 10 g/kg of NOC and 500 mg of raw fresh garlic, 500 mg of raw fresh red onion, and 500 mg of raw fresh white onion on 1 kg of body weight for Chol/Garlic, Chol/OnionRed, and Chol/OnionWhite diet groups, respectively. In order to detect the changes in the liver and aorta, a histological procedure was applied, and the liver enzymes were determined and compared. It was found that the main changes vs the Control group were in the liver of rats fed the cholesterol-containing diet without vegetable supplementation. Significantly less histological changes in the liver and lower level of liver enzymes vs those of the Chol group were detected in rats of the Chol/Garlic group (P < 0.05). The interaction between the polyphenol extract of garlic and BSA in vitro showed its strong ability comparable with that of quercetin to quench the intrinsic fluorescence of BSA. In conclusion, all studied vegetables showed protective effects, but raw garlic supplemented with cholesterol-containing diets significantly prevented the aorta and liver damages of rats.

KEYWORDS: Raw vegetables, bioactive compounds, antioxidant potential, rats, cholesterol-containing diets, aorta and liver damages

■ INTRODUCTION

Anthocyanins and polyphenols from various vegetables, fruits, and herbal plants have antioxidant activities. Flavonoids of vegetables prevent liver damage which occurs in rats fed cholesterol-containing diets.^{1–5} The physiological effects of red Welsh onion were examined and compared with those of white Welsh onion.² Nakayama et al.³ found in young male mice fed a high-fat diet that the numbers of the fatty droplets in the liver cytoplasm were markedly increased as well as the liver weight. The combined

modulatory effect of garlic and fish oils on the antioxidant and drug metabolic systems and the effect of onion byproduct on bioactivity and safety markers in healthy rats were studied.^{4,5} Some authors claim that herbal medicine and vegetables exercise hepatoprotective

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