EFFECT OF QUERCETIN ON ANTIOXIDANT STATUS OF RABBITS AFTER ONE MONTH EXPOSURE

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ABSTRACT

The aim of the present study was to investigate the short-term effect of quercetin in various doses on level of antioxidant enzymes in rabbit’s blood. Adult rabbits were divided into three experimental groups (E1, E2 and E3) and the control group without quercetin addition. Quercetin was applied intramuscularly in various concentrations; 10 µg.kg⁻¹ in E1 group, 100 µg.kg⁻¹ in E2 group, and 1000 µg.kg⁻¹ in E3 group for 30 days, 3 times per week. Application of quercetin insignificantly increased the level of SOD in the experimental groups in comparison with the control group. Gender comparison showed higher level of SOD in all experimental male groups in comparison with the female groups. The level of GPx activity decreased in all experimental groups but without significant differences. In gender comparison we found higher activity of GPx in female groups in comparison with the male groups. In conclusion, as the quercetin serves in organism as antioxidant with the ability to scavenge free radicals, our results could contribute to the positive effect of quercetin on antioxidant balance, however further studies are needed.

Keywords: rabbits, quercetin, superoxide dismutase, glutathione peroxidase, gender comparison

INTRODUCTION

Oxidative stress has been shown, both in experimental and clinical studies held in recent years, to play a key role in the pathogenesis of many diseases. Oxidative stress is effective on the pathological processes of diseases like cancer, cardiovascular diseases, rheumatoid arthritis, diabetes mellitus, and neurologic disorders such as Alzheimer and Parkinson (Valko et al., 2007). The increased reactive oxygen species (ROS) in human body has various sources such as auto-oxidative glycation, activation of protein kinase C, mitochondrial respiratory chain deficiencies and increased oxidase enzyme activities (Forbes et al., 2008; Derubertis et al., 1994). However, the body has its antioxidant system to prevent ROS production and the probable damages ROS can cause. The most important elements of the intracellular antioxidant defense are superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPx) enzyme activities (Altan et al., 2006).

Another molecule with a potent antioxidant effect is quercetin, a common flavonoid in nature. It exists in many nutrients, mostly in red onions, grapes, berries, cherries, broccoli, citrus fruits, tea (Camellia sinensis) and capers (Bischoff, 2008). Quercetin is able to preclude oxidative stress by directly inactivating free radicals, by inhibiting xanthine oxidase and lipid peroxidation, and by affecting antioxidant pathways both in vivo and in vitro (Hanasaki et al., 1994; Plumb et al., 1994; Fiorani et al., 2001; Morand et al., 1998). Quercetin, as a potent antioxidant agent, can be expected to reduce the damages in tissues caused by free radicals and by oxidative damages.

The aim of the present work was to determine effect of short-term application of quercetin in various doses on level of antioxidant enzymes in rabbit’s blood.

MATERIAL AND METHODS

Animals and diet

Adult female rabbits (n = 20) and male rabbits (n = 20) of meat line M91, maternal albinotic line (crossbreed New Zealand white, Buskat rabbit, French silver) and paternal acromalic line (crossbreed Nitra’s rabbit, Californian rabbit, Big light silver) were used in experiment. Rabbits were healthy and their condition was judged as good at the commencement of the experiment. Water was available ad libitum. Groups of adult animals were balanced for age (150 days) and body weight (4 ± 0.5 kg) at the beginning of the experiment. Adult rabbits were fed diet of a 12.35 MJ.kg⁻¹ of metabolizable diet (Table 1) composed of a pelleted concentrate.

Animals were divided into four groups (n=10 in each group), one control group (C) and three experimental groups (E1, E2 and E3). Experimental groups received quercetin in injectable form (intramuscularly) at 10 µg.kg⁻¹ in E1 group, 100 µg.kg⁻¹ in E2 group, and 1000 µg.kg⁻¹ in E3 group for 30 days 3 times a week. Control group received injection water (Imuna Pharma a.s. Sarišské Michaľany, Slovak Republic).

In this animal study, institutional and national guidelines for the care and use of animals were followed, and all experimental procedures involving animals were approved by the State Veterinary and Food Institute of Slovak Republic, no. 3398/11-221/3.

Blood sampling and analyses

After 1 month of intramuscular application of quercetin, blood samples from vena auricularis from all animals by macromethods were taken. The levels of superoxide dismutase (SOD) and glutathione peroxidase (GPx) were determined by spectrophotometric analysis (Genesys 10, Thermo Fisher Scientific Inc., USA).

Statistical analyses

The data used for statistical analyses represent means of values obtained in blood collection (end of the experiment). One-way ANOVA test was applied to calculate basic statistic characteristics and for determination of significant differences between the experimental and control groups. Statistical software SIGMA PLOT 11.0 (Jandel, Corte Madera, CA, USA) was used.
RESULTS AND DISCUSSION

It is known, that natural substances can cause changes in antioxidant status. In this study, the effect of short-term exposure of quercetin in various doses on selected antioxidant enzymes of rabbits was measured from blood. The results are presented in figures 1 - 4. SOD is important antioxidant enzyme responsible for the elimination of superoxide radical (Hu, et al., 2005). In our study quercetin treatment slightly increased the activity of SOD in rabbit’s blood. We observed insignificant (P > 0.05) increase in activity of SOD in experimental groups E1 and E3 and decrease in E2 group in comparison with the control group. Demir et al. (2011) found insignificant decrease in activity of SOD in rats after 4 week of quercetin treatment. These discrepancies in literature could be caused by using different kind of animals. In another study Huk et al. (1998) found that lower concentration of quercetin in blood increased SOD activity and higher concentration (up to 30 µmol.l⁻¹) of quercetin decreased SOD and declined beneficial effect. In our study the doses of quercetin used in experiment were low and similar to possible daily intake. Gender comparison revealed that the application of quercetin resulted in decrease of SOD level in all experimental female groups in comparison with male VSMC. According to authors de...

Table 1 Chemical composition (g.kg⁻¹) of the experimental diet

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter</td>
<td>926.26</td>
</tr>
<tr>
<td>Crude protein</td>
<td>192.06</td>
</tr>
<tr>
<td>Fat</td>
<td>36.08</td>
</tr>
<tr>
<td>Fibre</td>
<td>135.79</td>
</tr>
<tr>
<td>Non-nitrogen compound</td>
<td>483.56</td>
</tr>
<tr>
<td>Ash</td>
<td>78.78</td>
</tr>
<tr>
<td>Organic matter</td>
<td>847.49</td>
</tr>
<tr>
<td>Calcium</td>
<td>9.73</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>6.84</td>
</tr>
<tr>
<td>Magnesium</td>
<td>2.77</td>
</tr>
<tr>
<td>Sodium</td>
<td>1.81</td>
</tr>
<tr>
<td>Potassium</td>
<td>10.94</td>
</tr>
<tr>
<td>Metabolizable energy</td>
<td>12.35 MJ.kg⁻¹</td>
</tr>
</tbody>
</table>

Figure 1 The activity of SOD of rabbit’s blood after short quercetin exposure in vivo. C – control group, E1 - 10 µg.kg⁻¹, E2 - 100 µg.kg⁻¹, E3 - 1000 µg.kg⁻¹ of quercetin. Values are means ± SD

Figure 2 The activity of SOD of rabbit’s blood after short quercetin exposure in vivo, gender comparison. Cf/m – control group, E1/m - 10 µg.kg⁻¹, E2/f - 100 µg.kg⁻¹. Values are means ± SD

Figure 3 The activity of SOD of rabbit’s blood after short quercetin exposure in vivo. C – control group, E1 - 10 µg.kg⁻¹, E2 - 100 µg.kg⁻¹, E3 - 1000 µg.kg⁻¹ of quercetin. Values are means ± SD
The intramuscular application of the quercetin three times a week to the rabbits resulted in some changes in activity of antioxidant enzymes (SOD and GPx). Application of quercetin insignificantly increased the level of SOD in selected experimental groups in comparison with the control group and we found higher level of SOD in all experimental male groups in comparison with the female groups. The level of GPx activity decreased in all experimental groups but without significant differences. In gender comparison we found higher activity of GPx in female groups in comparison with the male groups. In conclusion, our results showed a positive effect of short-term application of quercetin on level of antioxidants enzymes. To our knowledge, there are not a lot of similar studies concerning the short-term effect of intramuscular application of quercetin and its effect on antioxidant status of rabbits. Research on the field of quercetin will be worthy of further investigation.

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