Effects of sesame oil in the model of adjuvant arthritis

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Abstract

OBJECTIVES: The goal of this study was to evaluate the effect of sesame oil on functional damage induced by adjuvant arthritis (AA) and on changes of selected biochemical parameters reflecting oxidative tissue injury.

DESIGN: Mycobacterium butyricum in incomplete Freund's adjuvans was intra-dermally administered to Lewis male rats. Hind paw edema and endothelium-dependent relaxation of the aorta were determined on day 28. Further, plasmatic levels of TBARS, gamma-glutamyltransferase (GGT) activity in the joint and spleen tissues, level of protein carbonyls and total antioxidant capacity (TAC) in plasma, as well as activity of the lysosomal enzyme N-acetyl-glucosaminidase (NAGA) in serum were assessed. The effect of sesame oil (SO, 1ml/kg, daily oral administration) was evaluated on day 28.

RESULTS: The beneficial effect of sesame oil on markers of oxidative stress accompanying AA was demonstrated by decrease of plasma TBARS and decrease of GGT activity in the joint and spleen tissues. Level of protein carbonyls, TAC in plasma and activity of NAGA in serum and in the kidney were improved, yet not significantly. In the hind paw edema the maximal increase was found on day 28 of AA, and in the same time we observed a significant decrease of aortic endothelium-dependent relaxation. Administration of SO resulted in mild, non-significant decrease of hind paw swelling and in significantly increased acetylcholine-evoked relaxation.

CONCLUSION: We conclude that SO has beneficial effects on oxidative stress induced biochemical changes occurring in AA, moreover it improves endothelium-dependent relaxation of the aorta and tends to decrease hind paw edema.

INTRODUCTION

SO is a component of the traditional health food in oriental countries. The oil was reported to have high antioxidant activity (Baba et al. 1998; Namiki, 2007), which contributes to its effects against increased blood pressure, hyperlipidemia and lipid peroxidation (Sankar et al. 2005). The principal antioxidant component of SO is sesaminol (Osawa et al. 1990), however phenol, sesamin, sesamol, sesamolin and relatively small amounts of tocopherol contribute to its oxidative stability (White, 1992). As oxidative stress is known to contribute to the pathogenesis of chronic inflammatory diseases such as rheumatoid arthritis, utilization of antioxidant activity of SO might be of importance in anti-arthritic therapy.

The present study was undertaken to assess the effect of SO on functional damage induced by AA.
and on changes of selected biochemical parameters reflecting oxidative tissue injury.

MATERIAL AND METHODS

After approval by the local ethical committee, AA was induced in male Lewis rats (150–170 g) by a single intradermal injection of heat-inactivated Mycobacterium butyricum in incomplete Freund's adjuvant. The experiments included healthy intact rats (C), arthritic rats (AA), and arthritic rats treated with SO (AA+SO), with 8 rats in each group. SO was administered daily (1 ml/kg body weight, orally) from the day of bacterial inoculation. On day 28 the animals were sacrificed and the following biochemical parameters were measured: TAC in plasma by the 2,2'-azinobis(3-ethylbenzothiazoline 6-sulfonate) assay (Rice-Evans & Miller, 1994), protein carbonyl groups in plasma using enzyme linked immunosorbent assay, as described by Buss et al.

Table 1. Markers of oxidative stress in control rats, rats with adjuvant arthritis (AA), and rats with adjuvant arthritis treated with sesame oil (AA+SO). Values are means ± SEM of 8 animals.

<table>
<thead>
<tr>
<th>Parameters measured</th>
<th>Control</th>
<th>AA</th>
<th>AA + SO</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBARS in plasma (nmol/ml)</td>
<td>12.0 ± 0.78</td>
<td>16.4 ± 1.61</td>
<td>13.75 ± 1.39</td>
</tr>
<tr>
<td>GGT activity in the joint (nmol p-nitroaniline/min/g wet weight)</td>
<td>14.08 ± 2.44</td>
<td>23.46 ± 0.82</td>
<td>15.85 ± 2.91</td>
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<tr>
<td>GGT activity in the spleen (nmol p-nitroaniline/min/g wet weight)</td>
<td>14.02 ± 2.77</td>
<td>84.54 ± 8.59</td>
<td>65.78 ± 4.69</td>
</tr>
<tr>
<td>Protein carbonyls in plasma (nmol/mg protein)</td>
<td>1.12 ± 1.19</td>
<td>10.0 ± 0.76</td>
<td>9.61 ± 0.62</td>
</tr>
<tr>
<td>TAC in plasma (nmol/l)</td>
<td>0.09 ± 0.02</td>
<td>0.04 ± 0.02</td>
<td>0.05 ± 0.01</td>
</tr>
<tr>
<td>NAGA activity in serum (µg 4-nitrophenol/min/mg protein)</td>
<td>0.044 ± 0.003</td>
<td>0.066 ± 0.003</td>
<td>0.062 ± 0.002</td>
</tr>
</tbody>
</table>

Abbreviations

AA    adjuvant arthritis
GGT   gamma-glutamyltransferase
HPV   hind paw volume
NAGA  N-acetyl-glucosaminidase
SEM   standard error of mean
SO    sesame oil
TAC   total antioxidant capacity
TBARS thiobarbituric acid reactive substances
CYP   cytochrome P450

RESULTS AND DISCUSSION

As shown in Table 1, AA induced changes in all biochemical parameters tested. The beneficial effect of SO was demonstrated by a significant decrease in plasma TBARS and decrease in GGT activity in joint and spleen tissue homogenates. Levels of protein carbonyls, TAC in plasma and activity of NAGA in serum were slightly improved, yet not significantly.

A maximal increase in HPV (Fig.1) and significant decrease in aortic endothelium-dependent relaxation was found on day 28 of AA (Fig. 2). Administration of SO resulted in mild, non-significant decrease in HPV and in significantly increased acetylcholine-evoked relaxation.

Changes in biochemical parameters measured, as well as impaired endothelial function and hind paw swelling confirmed that besides inflammation also oxidative stress is involved in AA establishment. Further, our results are indicative of beneficial effects of SO in AA. This is in good agreement with results of other authors who found antioxidant activity of SO (Saif et al. 2006) and its individual components, e.g. lignan sesaminol (Kang et al. 1998). The mechanism of antioxidant effect of sesaminol, the major antioxidant component of SO, consists in increase of vitamin E levels in plasma and tissues by inhibition of CYP enzymes, which are responsible for vitamin E decomposition (Yamashita et al. 2007). Another component of SO – sesamin is probably responsible for antiinflammatory activity of SO (Willis, 1981; Mathias & Dupont, 1985).

In our experiments we observed impaired endothelial function of the aorta of rats with AA. AA-induced endothelial dysfunction was reported also by Haruna et al. (2006), who found that NAD(P)H oxidase and uncoupled edothelial NO synthase were responsible for the increased vascular oxidative stress and consequently for endothelial dysfunction in AA. Improvement of aortic endothelial function induced by SO administra-
tion, found in our experiments, is further evidence of the participation of oxidative stress in AA and simultaneously of antioxidant properties of SO.

**CONCLUSIONS**

Sesame oil has beneficial effects on oxidative stress induced biochemical changes occurring in adjuvant arthritis, moreover it improves endothelium-dependent relaxation of the aorta and tends to decrease hind paw edema. Our results suggest that oral administration of sesame oil could contribute to the treatment of rheumatoid arthritis, as well as other diseases with oxidative stress involved in their pathogenesis.

**Acknowledgements**

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**REFERENCES**


