The effects of ethanol extracts of rice bran, red adlay and *Echinacea spp* roots on alleviating colitis in DNBS-induced mice

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Abstract

Ulcerative colitis (UC) is a chronic inflammatory bowel disease (IBD) with a frequent relapse inflammation in the colon, which may result in diarrhea, dehydration and perforation. The etiology of UC remains unknown. Several dietary components with anti-oxidant and anti-inflammatory activities have been reported to prevent the recurrence of UC. The aim of this study was to investigate the effects of the ethanol extracts of rice bran, red adlay, *Echinacea purpurea* roots and *E. pallida* roots on alleviating the clinical symptoms, inflammation and colon damages in UC. Male C57BL/6JNarl mice were intra-rectally injected with 2,4-dinitrobenzene sulfonic acid (DNBS, 200 mg/kg) to induce colitis (day 0). From day 3 to 24, UC mice were fed with the AIN-93M diet (UC group) or the diet supplemented with 70% ethanol extracts of rice bran (RBE group), red adlay (ADE group), *E. purpurea* roots (PEP group) or a mixture of *E. purpurea* and *E. pallida* roots (APP group). These mice were re-activated by DNBS (100 mg/kg) on day 21 to mimic colitis relapse and killed on day 24. Healthy normal rats fed with AIN-93M diet (R group) were included as controls. The results showed that the UC group had significantly higher levels of disease activity index (DAI) and plasma glutathione and lower levels of plasma interleukin (IL)-10 and colonic claudin 4 than the R group ($p<0.05$, one-way ANOVA and Duncan's multiple range test). In the colon, the scores of edema, immune cell infiltration, loss of goblet cells and inflammation were significantly higher in the UC group than in the R group ($p<0.05$, Kruskal Wallis test and Mann Mann–Whitney U test). In addition, the PEP group had increased plasma IL-6; the RBE had

increased colonic claudin 4; the PEP and APP groups had decreased colonic occludin; the ADE, PEP and APP groups had increased colonic collagen content; and the RBE ADE, PEP and APP groups had significantly decreased plasma TNF-α, IFN-γ, IL-10, IL-12p70 and MCP-1 and glutathione compared to the UC group. In conclusion, oral administration of ethanol extracts of rice bran, red adlay and *Echinacea* roots may mitigate the innate and adaptive immune responses and reversed the UC-increased colonic GSH content in UC mice. In addition, the ethanol extract of rice bran may have beneficial effects in preserving the colonic integrity in UC mice. However, the adverse effects of ethanol extracts of red adlay and *Echinacea* roots on colonic fibrosis need to be concerned.

Keywords: inflammatory bowel disease; ulcerative colitis; disease activity index; cytokines; tight junction; red adlay; *Echinacea*

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