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Original Article

Scutellaria baicalensis ameliorates the destruction of periodontal ligament via inhibition of inflammatory cytokine expression

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Abstract

Background: *Scutellaria baicalensis* (SB) is widely used as a medicinal plant to treat various inflammatory diseases. In the present study, we investigated the effects of SB on periodontitis in ligature-induced experimental rat model.
Methods: Rats were subjected to a ligature placement around the first molar of the mandible to induce periodontitis. 100 mg/kg SB extracts were orally administered for 14 days. The molar tissues were stained with 1% methylene blue. Histopathological changes of the periodontium were observed by hematoxylin and eosin staining. The levels of cytokines were measured in the gingival tissue.
Results: Alveolar bone resorption was statistically lower in the SB group compared to the ligatured group. SB inhibited the mineralization of cementum. In addition, SB reduced the production of IL-1β, 6, -8 and TNF-α cytokine mRNA expression in gingival tissues.
Conclusion: These results suggest that SB showed ameliorative effects in the ligature-induced periodontitis by inhibition of inflammatory cytokine expression.

Keywords: Alveolar bone loss; Cytokines; Inflammation; Periodontitis; *Scutellaria baicalensis*

1. Introduction

Periodontitis is a common inflammatory disease of tooth-supporting tissues including alveolar bone, cementum, periodontal ligament and gingiva.[1] The primary etiology of periodontal breakdown is the plaque accumulation associated with several species of bacteria such as *Porphyromonas gingivalis*, *Bacteroides forsythus* and *Treponema denticola*.[2] Microbes and their products can initiate periodontal inflammation and induce host immune response. In this process of reaction, immune cells and fibroblasts release various inflammatory molecules that activate the effectors of tissue destruction and further lead to formation of periodontal pocket, loss of tooth attachment and resorption of alveolar bone.[3,4]

Treatment of periodontitis mainly relies on mechanical removal of subgingival plaque and prevention of its accumulation.[5] Instrumental debridement, regarded as an efficient therapy for periodontitis, is not always successful in complete elimination of pathogenic bacteria, especially within the furcation area.[6] In addition, antimicrobial agents are commonly prescribed as adjuvants for infection control. However, a number of studies have been reported that antimicrobial therapies have various adverse effects such as nausea, colitis, diarrhea, dizziness and bacterial resistance.[7] Recently, there has been growing interest in natural products as sources of alternative for periodontal therapy.

The root of *Scutellaria baicalensis* Georgi (Labiatae) is a traditional medicinal herb used extensively in Northeast Asia to treat inflammatory diseases including high fever, diarrhea, dysuria and hematuria.[8] In addition, various studies have confirmed that *S. baicalensis* has anti-inflammatory, anti-

Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

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oxidant, anti-diabetic, neuroprotective and anti-tumor activities.[9–13] In particular, anti-periodontitis effects of *S. baicalensis* by inducing T helper 2-type IgG1 levels have been demonstrated.[14] Baicalin, a main component of *S. baicalensis*, was reported to inhibit tissue damage with its inhibitory effect on cyclooxygenase-2 and inducible nitric oxide synthase expressions.[15] However, the effects of *S. baicalensis* water extract (SB) on periodontitis and underlying mechanism via inhibition of inflammatory cytokines have not been fully defined. The aim of the present study was to evaluate whether *S. baicalensis* could recover alveolar bone loss (ABL) and destruction of ligament tissues by its anti-inflammatory effects in ligature-induced periodontitis in rats.

2. Methods

2.1. Preparation of sample

S. baicalensis roots were obtained from Jung-do Herb, Co., Ltd. (Seoul, Korea). 50 g of dried *S. baicalensis* was extracted with 1 L boiling distilled water for 1 h 30 min. The extracts were filtered, concentrated and lyophilized. The dry weight of the *S. baicalensis* was 16.4 g (yield: 32.77% (w/w)). The voucher specimens were deposited at our laboratory. SB was identified by three standards, baicalin, baicalein and wogonin, using an Agilent Series 1100 HPLC system (Palo Alto, CA, USA) with a binary pump, an auto-sampler, a column oven, and a diode array detector (DAD). The Shiseido UG 120 column (250 × 4.6 mm, 5 μm) was tested with a guard column. The analysis was carried out at a flow rate of 1.0 mL/min with the detection wavelength at 280 nm. The HPLC peaks on SB were synchronized with baicalin, baicalein and wogonin (Fig. 1).

2.2. Animals

Sprague–Dawley rats (male, 7 weeks old) obtained from RaonBio, Inc. (Yongin, Korea). The animals were housed for acclimatization for 1 week. All rats were maintained under standard conditions with controlled temperature and humidity (22 ± 1 °C and 50 ± 5%), under 12-h light/dark cycle. The rats were provided with free access to standard rat chow and water. All experimental procedures were examined and approved by the Committee on the Care and Use of Laboratory Animals of Kyung Hee University (KHUASP(SE)-14-029).

2.3. Experimental design

The rats were randomly divided into three groups (n = 7); NOR, LIGA and SB. In NOR group, rats were non-ligatured with vehicle treatment; In LIGA group, rats were ligatured with vehicle treatment; in SB group, rats were ligatured and treated with 100 mg/kg SB. To induce periodontitis, ligature was placed into the proximal space between the first and

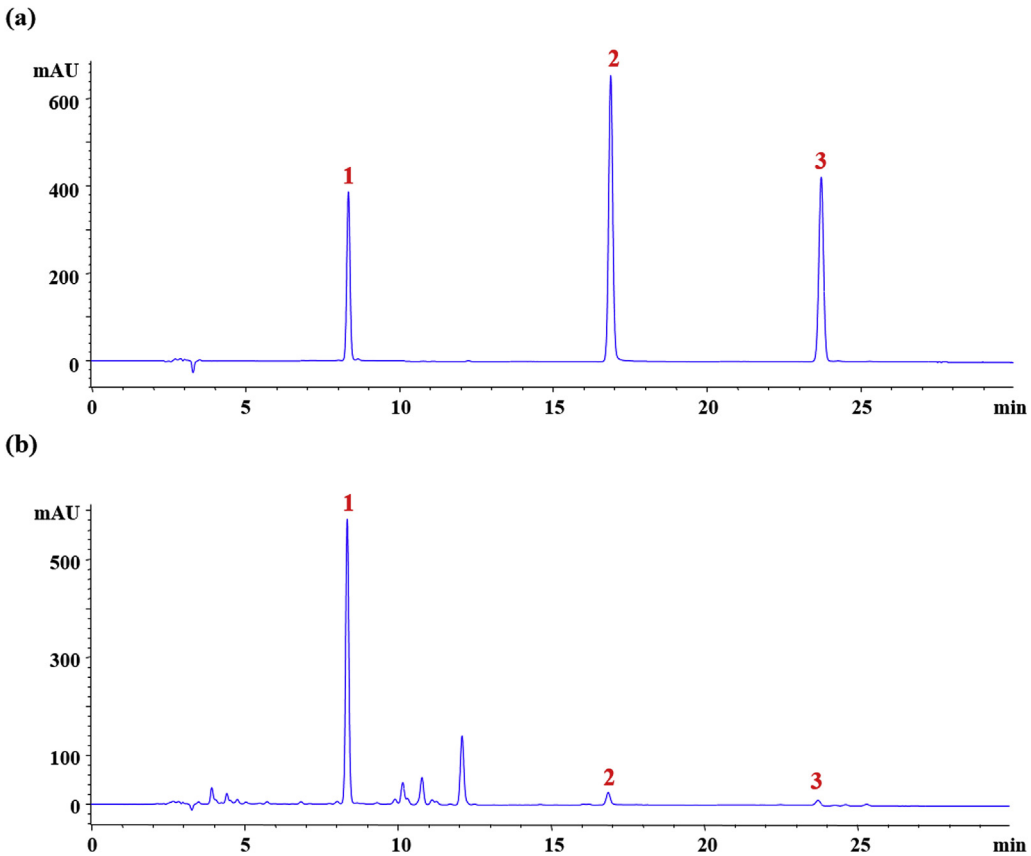

Fig. 1. Identification of SB. HPLC chromatograms of (a) authentic standards (1. Baicalin, 2. Baicalein, 3. Wogonin) and (b) SB.

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