Anti-Gastritis and Anti-Oxidant Effects of *Chenopodium album* Linne Fractions and Betaine

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**Abstract** — *Chenopodium album* Linne (CAL) is a fast-growing weedy annual plant. The leaves and young shoots may be eaten as a leafy vegetable. In oriental medicine, CAL has been used for treatment of skin disease, fever, stomach ache, toothache, and paralysis. After a preliminary screening of CAL ethanol extract and its fractions obtained from CAL leaves for anti-gastritic and anti-*Helicobacter pylori* (*H. pylori*) activity, the butanol (BuOH) fraction was found to have the most significant effect. We also examined antioxidative properties of the total CAL extract and its fractions, and also betaine as an ingredient of the BuOH fraction. To investigate the antioxidant effects of CAL on gastritis, the reducing power, free radical scavenging activity using 1,1-diphenyl-2-picrylhydrazyl (DPPH), and lipid peroxidation effects were determined. Additionally, the BuOH fraction reduced cell viability in a concentration dependent manner in human gastric cancer cell lines. The results of this study revealed that CAL has excellent antioxidant activity, and may be useful in treating gastritis and gastric cancer.

**Keywords:** *Chenopodium album* Linne, Betaine, Anti-gastritis, Anti-oxidant, Anti-*Helicobacter pylori*, Cell viability

**INTRODUCTION**

*Helicobacter pylori* (*H. pylori*) is a cause of chronic gastritis (NIH Consensus Conference, 1994) and gastric ulcers (Blaser, 1992), and is a risk factor for stomach cancer (Parsonnet et al., 1991). *H. pylori* is spread throughout the entire world; 64-95% of chronic gastritis patients and 35-86% of gastric ulcer patients are infected with *H. pylori* (Megraud and Lamouliatte, 1992). From the perspective of the “Balance Theory,” according to which gastric mucous membrane damage in gastric ulcers is caused by an imbalance between aggressive and defensive factors in the stomach, *H. pylori* is believed to alter the defensive factors and lead to excessive acid production (Shay et al., 1945; Leunk et al., 1988). The cause of gastric mucous membrane damage related to *H. pylori* was initially explained by toxic factors such as cytotoxin, urease, and ammonia. However, it has been recently reported that phagocytes, which produce excessive amounts of reactive oxygen metabolites, are also partially responsible. Unlike *H. pylori*, cimetidine, ranitidine, and proton pumps (*H⁺/K⁺* ATPases) are among the types of *H₂*-antagonists which are the most well-known inhibitors of aggressive factors and stimulators of defensive factors (Robert et al., 1979; Chandranath et al., 2002). Research on platelet activating factor antagonists, phosphodiesterase inhibitors, selective *M₁*-antagonists, gastrin inhibitors, and cytoprotective drugs is ongoing (Uchida et al., 1989), and it is predicted that future gastritis and gastric ulcer research will be focused on *H. pylori* and antioxidant and anti-inflammatory substances. Thus, drug development research, along with the existing antacid medications, should shift focus to the pathogenesis of gastric ulcers caused by *H. pylori* and the development of anti-inflammatory drugs.

*Chenopodium album* Linne (CAL) was selected for this study, since it has long been used as a folk remedy due to its effectiveness in treating various illnesses such as neuralgia, gastralgia, and hepatocirrhosis. Young leaves of CAL, an annual plant of Chenopodiaceae, are edible, and contain essential oils, amino acids, ascorbic acid, saponin, mucus, ferulic acid, vanillic acid, betaine, lycium, barparum, and propylamin. In oriental medicine, CAL is called “Yeoh” and is gathered from May to June. Both dried and fresh

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decoct of “Yeoh” have been used for treatment of dysentery, strengthening of the stomach, alleviation of fever, detoxification, prevention of stroke, alleviation of toothache, stomach ache, labor pains, treatment of tuberculosis, and tonics. Juice of CAL leaves can be applied on the skin to treat and alleviate symptoms of Prurigo nodularis, scabies, eczema, hemorrhoids, and poisonous insect bites. Betaine is contained in the CAL BuOH fraction and was named after its discovery in sugar beets (\textit{Beta vulgaris}) during the 19\textsuperscript{th} century. This substance is widely distributed in microorganisms, plants, and animals. Betaine is a white crystal with a formula of C\textsubscript{5}H\textsubscript{11}NO\textsubscript{2} (Fig. 1) and has a slight odor and sweetness. Betaine is anti-glycemic, lipotropic, and active in detoxification and cellular replication. Hydrochloric acid, released from betaine-HCl, may help alleviate symptoms of lack of gastric acid. Potential uses of CAL were investigated for the treatment of acute and chronic gastritis. The HCl/ethanol-induced mucosal membrane lesion model was used for acute gastritis, and the indomethacin induced gastric lesion model was used for chronic gastritis. The antibacterial activity on \textit{H. pylori} and the cytotoxicity on SNU638 and AGS cells, along with the antioxidant activities of CAL EtOH extract, its extract fractions, and betaine were also investigated. Therefore, by confirming its antioxidative mechanism, the study sought to provide scientific rationale for using a natural substance such as CAL.

**MATERIALS AND METHODS**

**Reagents**

Dimethyl sulfoxide (DMSO), 1,1-diphenyl-2-picrylhydrazyl radical (DPPH), 3-(4,5-dimethylthiazol-2,5-diphenyltetrazolium bromide (MTT), trypan blue, cimetidine, hydroxylate and ampicillin were obtained from Sigma (Sigma-Aldrich Inc., MO, USA). Cell culture media and reagents, including Hank’s balanced salt solution, RPMI 1640, fetal bovine serum (FBS), penicillin/streptomycin, and trypsin-EDTA were obtained from GIBCO (Invitrogen Inc., NY, USA). HCl, EtOH, and other solvents were purchased from Duksan pure Chemical Co. Ltd. (Kyunggi-do, Korea). All other reagents were of pharmaceutical or analytical grade.

**Laboratory equipment**

Equipment included: evaporator (Eyela), pH meter (IQ Scientific Instruments, Inc), Clean Bench (Johnsam Co.), CO\textsubscript{2} incubator (Forma Scientific), water bath (Vision), inverted microscope (Olympus), autoclave (Duksan Chem. Co.), micropipette (Gilson Co.), centrifuge 5810R (Eppendorf), high speed centrifuge (Sorvall RT-6000), AnaeroPack Campyo (Mitsubishi Gas Chemical Co., Inc.), liquid nitro-