Screening test for anti-\textit{Helicobacter pylori} activity of traditional Chinese herbal medicines

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Abstract

AIM: To evaluate the anti-\textit{Helicobacter pylori} (\textit{H. pylori}) activity of 50 traditional Chinese herbal medicines in order to provide the primary evidence for their use in clinical practice.

METHODS: A susceptibility test of water extract from 50 selected traditional Chinese herbal medicines for \textit{in vitro} \textit{H. pylori} Sydney strain 1 was performed with broth dilution method. Anti-\textit{H. pylori} activity of the selected Chinese herbal medicines was evaluated according to their minimum inhibitory concentration (MIC).

RESULTS: The water extract from Rhizoma Coptidis, Radix Scutellariae and Radix isatidis could significantly inhibit the \textit{H. pylori} activity with their MIC less than 7.8 mg/mL, suggesting that traditional Chinese herbal medicines have anti-inflammatory and antibacterial effects and can thus be used in treatment of \textit{H. pylori} infection.

CONCLUSION: Rhizoma Coptidis, Radix Scutellariae and Radix isatidis are the potential sources for the synthesis of new drugs against \textit{H. pylori}.

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Key words: Chinese herbal medicines; \textit{Helicobacter pylori}; Minimum inhibitory concentration; Gastric; Oral

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INTRODUCTION

\textit{Helicobacter pylori} (\textit{H. pylori}), a microaerophilic, Gram-negative spiral bacterium which was first detected in 1984 by Marshall et al\cite{1}, is one of the most common chronic bacterial pathogens in humans. Approximately 50% of people in the world are infected with it, and its prevalence is significantly higher in developing countries than in developed countries\cite{2}. \textit{H. pylori} infection is an important etiologic impetus usually leading to chronic gastritis, gastroduodenal ulcer and low grade gastric mucosa-associated lymphoid tissue lymphoma. Epidemiological data show that a high \textit{H. pylori} infection rate is related to the high incidence of gastric cancer and gastric adenocarcinoma\cite{3}. World Health Organization has categorized \textit{H. pylori} as...
a class 1 carcinogen\(^5\). Fortunately, its eradication with antibiotics can result in ulcer healing, prevent peptic ulcer recurrence and reduce the prevalence of gastric cancer in high-risk populations\(^6\). However, it is not always successful because of its resistance to one or more antibiotics and other factors such as poor patient compliance, undesirable side effects of the drugs and significant cost of combination therapy. Worrel \textit{et al.}\(^7\) reported that over 15\% of the patients undergoing antibiotics therapy would experience therapeutic failure. In developing countries, since the application of antibiotics is still under a poor management as a whole, there is a growing need for finding new anti-\textit{H. pylori} agents that can hopefully eradicate the invasion and presence of \textit{H. pylori} strains to avoid relapse of gastric ulcer. Hence, a considerable variety of studies involving tests for medicinal plants showing antimicrobial activity and discrepant susceptibility test results are available due to variations in the methods and conditions used for its susceptibility testing. It was reported that Garlic extracts exhibit a weak or modest anti-\textit{H. pylori} activity\(^7\). \textit{Prelepsis suberosa}\(^8\), \textit{Cinnamon}\(^9\), \textit{Craberry juice}\(^10\), \textit{Aristolochia paucinervis} Pomel\(^11\), \textit{black Myrobalan}\(^12\), etc., have also been found to have anti-\textit{H. pylori} activities. Ndip \textit{et al.}\(^13\) reported that \textit{Ageratum conyzoides}, \textit{Scleria striatinux} and \textit{Lycopodium cernua} show a very potent antibacterial activity. Fifty-four herbal medicines from Korea have been screened for their anti-\textit{H. pylori} activity, of which, \textit{Rheum palmatum}, \textit{Rhus javanica}, \textit{Coptis japonica} and \textit{Eugenia caryophyllata} have a strong anti-\textit{H. pylori} activity\(^14\). Extracts and fractions from 7 Turkish plants also demonstrate anti-\textit{HP} activities\(^15\). Traditional medicinal plants from Pakistan and \textit{Psoralea corylifolia} L. demonstrate a strong anti-\textit{H. pylori} activity\(^16\). Some compounds even have been isolated and their anti-\textit{H. pylori} activity has also been testified, for example, \textit{Myroxylon Periferum} from the Brazilian medicinal plants\(^17\). In addition, some flavonoids and isoflavonoids isolated from licorice, such as licochalcone A and licisofoflavone B, have been reported to exhibit inhibitory activities against \textit{H. pylori}\(^18\).

In China, traditional Chinese medicine and pharmacology play an indispensable role in the health care system, especially in prevention and management of chronic diseases. Studies\(^19\) revealed that some traditional herbal medicines are efficient against gastrointestinal diseases, including chronic gastritis and peptic ulcer disease, a major outcome of \textit{H. pylori} infection, indicating that the medicinal plants may contain constituents, which have antibacterial and anti-inflammatory activities. The present study was to evaluate the anti-\textit{H. pylori} activity of some selected medicinal plants to identify the potential sources for synthesis of new drugs against \textit{H. pylori}. In this study, 50 traditional Chinese medicinal herbs (Table 1) were examined and screened for their anti-\textit{HP} activity according to their minimum inhibitory concentration (MIC).

**MATERIALS AND METHODS**

**Extract of medicinal plants**

A total of 50 traditional Chinese medicinal herbs, pur-
| Chinese name  | English name   | Pharmaceutical name | Botanical name                          | MIC (mg/mL) |
|--------------|---------------|----------------------|----------------------------------------|-------------|
| Huanglian    | Coptis Rhizome| Rhizoma Coptidis      | Coptis chinensis Franch.                | 3.9 ± MIC ≤ 7.8 |
| Huangqin     | Baikal skullcap Root | Radix Scutellariae | Scutellaria Baicalensis Georgi.         | 3.9 ± MIC ≤ 7.8 |
| Banlangen    | Indigowood Root | Radix isatisid       | Isatis tinctoria L.                     | 3.9 ± MIC ≤ 7.8 |
| Jinyinhu     | Honeysuckle Flower | Floslonicereae Japonicae | L. Similis Hemsil                       | 7.8 ± MIC ≤ 15.6 |
| Qinpi        | Largeleaf Chinese Ash Bark | Cortex Fraxini | F. Bungeana DC.                        | 7.8 ± MIC ≤ 15.6 |
| Zhihuadiding | Tokyo Violet Herb | Herba Violae cum Radice | Viola yedoensis Mak.                  | 15.6 ± MIC ≤ 31.2 |
| Huangbai     | Chinese Corkreek Bark | Cortex Pheliodendreri | Chinese Schweid                        | 15.6 ± MIC ≤ 31.2 |
| Daqingyinge  | Indigowood Leaf | Folium isatisid      | Isatis                                | 15.6 ± MIC ≤ 31.2 |
| Puqingyinge  | Dandelion     | Herba Taraxaci Mongolicum cum Radice | Taraxacum mongolicum                 | 15.6 ± MIC ≤ 31.2 |
| Dahuang      | Rhubarb Leaf  | Rhizoma Rhei         | R. Officinale baiil                    | 31.2 ± MIC ≤ 62.5 |
| Shandougen   | Tonkin sorora Root | Radix Sororae Tonkinensis | Sophora Subprostrata Chun et T. Chen | 31.2 ± MIC ≤ 62.5 |
| Longdancao   | Chinese Gentian Root | Radix Gentianae Scabrae | Gentiana Scabrae Bge. In              | 31.2 ± MIC ≤ 62.5 |
| Hezi         | Medicine Terminalia Fruit | Fructus Terminaleae Chebulae | Terminalia chebula Retz.            | 31.2 ± MIC ≤ 62.5 |
| Machixian     | Parslane Herb | Radix Sororae Subprostratae | Sophora Subprostrata Chun et T. Chen | 62.5 ± MIC ≤ 125 |
| Banhilian     | Barbed Skullcap Herb | Herba Scutellariae Barbatae | Scutellaria Barbata D. Don            | 62.5 ± MIC ≤ 125 |
| Yuxingcao     | Heartleaf Houttuynia Herb | Herba Houttuyniae Cordatae | Houttuynia cordata Thunb.             | 62.5 ± MIC ≤ 125 |
| Tufaling     | Glabrous Greenbriher Rhizome | Rhizoma Similicis Glabre | Similax glabra Roxb.                  | 62.5 ± MIC ≤ 125 |
| Niubangi     | Great Burdock Achene | Fructus Arctici Lappa | Fructus Arctii                        | 125 ± MIC ≤ 250 |
| Juhua         | Chrysanthemum Flower | Flos Chrysanthemi Morfoli | Chrysanthemum morfolii Ramat.         | 125 ± MIC ≤ 250 |
| Baijiangcao   | Whiteflower Patrinia Herb | Herba Whiteflower Patrinia Herb | Patrinia Scabiosaefolia Fisch.         | 125 ± MIC ≤ 250 |
| Tianhuafen    | Snakegourd Root | Radix Trichosanthis | Thichosanthes kinilowii Maxim.        | 125 ± MIC ≤ 250 |
| Yadanzi       | Java Brucea Fruit | Fructus Bruecae Iavanicae | Brueca Javanica Merr.                 | 125 ± MIC ≤ 250 |
| Niuhuang      | Cowcear | Calzulus Bovis | Bos taurus domesticus Gmelin         | 250 ± MIC ≤ 500 |
| Mabo          | Puff-ball | Fructifictio lasisphaeriae | Iasiophora fenselli Reih.             | 250 ± MIC ≤ 500 |
| Zisu         | Perilla Leaf | Folium Perillae Frutescencis | Perilla                              | 250 ± MIC ≤ 500 |
| Chaizhu       | Chinese Thorowat Root | Radix Bupleuri | Bupleurum scorzoneraeofolium         | 250 ± MIC ≤ 500 |
| Rendongteng   | Honeymyone Stem | Caulis Lonicerae | Loniceria Japonica                     | 250 ± MIC ≤ 500 |
| Kussen         | Lightyellow Sophora Root | Radix Sororae Flavescentsis | Sophora Flavescens Ait                | 250 ± MIC ≤ 500 |
| Rougui       | Cassia Bark | Cortex Cinamomoni Cassiae | Cinnamomum cassia Pres.               | 500          |
| Congbai       | Fistular Onion Stalk | Herba Ali Fistulata | Allium fistulatum                      | 500          |
| Xiangru       | Haichow Elsholtzia Herb | Herba Elsholtziales Splendentis | E. Haichowensis Sun.                | 500          |
| Bohe          | Wild Mint | Herba Mentheae | Mentha hlapoclyax Bryq.               | 500          |
| Qinghao       | Sweet Wormwood | Herba Artemisiae Apiaceae | Artemesia apiaca Hance               | 500          |
| Wuzhuoyu      | Medicinal Evodia Fruit | Fructus Evodiae Rutacearpace | Evodia Rutacearpeta Benth.           | 500          |
| Chishaoyao    | Red Peyony Root | Radix Paenodi Rubra | Paonia lactiflora Pall.               | 500          |
| Wumei        | Smoked Plum | Fructus Pruni Mume | Prunus mumeie Sieb. et Zucc          | 500          |
| Mudanpi       | Tree Peyony Bark | Cortex Moutan Radicis | Paonia suffructiosa And.             | 500          |
| Xuanxiao      | Figwot Root | Radix Scrophulariae Nigroennis | Scrophularia ningroennis Hemsd | 500          |
| Ganjiang      | Dried Ginger | Rhizoma Zingibereis Officinalis | Zingiber officinalis Rose             | 500          |
| Fuzi          | Root of Common Moonshood | Radixaconitil Carnichiaelli Praeparata | Aconite carniichiaelli Debs.         | 500          |
| Huaijiao      | Bange prickyloss | Fructus Zanthoxyli Bungeani | Zanthoxylum bungeanum Maxim.         | 500          |
| Gaoliangiang   | Lesser Galangal Rhizome | Rhizoma Alpiniae Officinarum | Alpinia officinarum Hance.           | 500          |
| Dingsxang     | Clover Fluwe-bud | Flos Caryophylli | Eugenia caryophylla Thunb.            | 500          |
| Shiluipi      | Rind Feel | Pericarpium Punicae Granatii | Punica granatuum L.                | 500          |
| Xinm         | Manchurian wildingger Herb | Herba Asari cum Radix | Asarum sieboldii Miq.                 | 500          |
| Cangzhu       | Swordlike Atractylodes | Rhizoma Atractylodes | Atractylodes lancea Thunb.            | 500          |
| Lugon         | Reed Rhizome | Rhizome Phragmitis Communinis | Phragmites communis                     | 500          |
| Baitouweng    | Chinese pulsatilla Root | Radix pulsatiliae Chinensis | Pulsatilia Chinensis Reg.            | 500          |
| Xiaohuixiang  | Fennel Fruit | Fructus Foeniculi vulgaris | Foeniculum vulgare Mill.            | 500          |
| Zhizi         | Cape Jasmine Fruit | Fructus Gardeniae Jasmilikiis | Gadenia Jasmonidios Ellis             | 500          |

MIC: Minimum inhibitory concentration.

15 min. No. 11 tube was used as a growth control (broth with bacterial inoculum, no extract) and No. 12 tube was used as a sterility control (broth only). All tubes were cultured in a shaking incubator containing 5% O₂, 10% CO₂, and 85% N₂. At the same time, 10 μL bacterial suspension from No. 11 tube was diluted quickly with 10 mL 0.9% sterile physiological saline at 1:1000, then 100 μL 0.9% sterile physiological saline was transferred onto the surface of three Campylobacter plates [control of diarrheal diseases in China Research, Shanghai Regent Supply; each liter containing bio-polyone (10 g), bio-lysat (10 g), bio-myotone (3 g), corn starch (1 g), sodium chloride (5 g), agar (13.5 g), pH 7.3, autoclaved at 121°C for 15 min] containing 5% (v/v) of sterile defibrinated sheep blood (Guangzhou Ruite Ltd., China), cultured at 37°C in a jar system (Refrigerating Machine Factory, Yiwu City, Zhejiang Province, China) containing 5% O₂, 10% CO₂, and 85% N₂: to verify the absence of contamination and calculate the colonies. Susceptibility test for other medicinal plants was performed in duplicate.
RESULTS

After incubation, the tubes were visually examined to determine whether the H. pylori strains grew. H. pylori strains in No. 11 tube grew well and no bacterial growth was observed in No. 12 tube. The colonies in 3 agar plates grew well with an average number of about 50. The lowest concentration (highest dilution) of extract that inhibited the visible growth of H. pylori strains (no turidity) was defined as MIC. For further confirmation, 10 μL of bacterial suspension from the clearly visible tubes was diluted quickly with 10 mL 0.9% sterile physiological saline at 1:1000, then 100 μL 0.9% sterile physiological saline was transferred onto the surface of three Campylobacter plates and cultured for 3 d. When the average number of colonies in the 3 agar plates was less than 5 or no colony was found, the MIC was considered less than or equal to the concentration. When the growth of H. pylori strains occurred in all dilutions containing the extract, the MIC was considered greater than the highest concentration. When no growth of H. pylori strains occurred in any concentration tested, the MIC was considered less than the lowest concentration. When a tube with visible growth of H. pylori strains, e.g. growth at 500, 250 and 62.5 mg/mL, but not at 125 mg/mL, was called a skipped tube and ignored. Growth of H. pylori strains in isolated tubes indicated contamination, the test should be repeated. The results are listed in Table 1. The MIC of Rhizoma Coptidis, Radix Scutellariae and Radix Isatidis was less than 5.8 mg/mL. The MIC of Floslionicarum Japonicae and Cortex Fraxini was less than 15.6 mg/mL. The MIC of Herba Violaecum Radice, Cortex Phellodendri and Folium Isatidis, Herba Taraxaci Mongolicum cum Radice was less than 31.2 mg/mL. The MIC of Rhizoma Rhei, Radix Sophorae Tonkinensis, Radix Gentianae Scabrae, Frutus Terminaliae Chebulicae was less than 62.5 mg/mL. The MIC of Radix Sophorae Subprostratae, Herba Scutellariae Barbatae, Herba Houttuyniae Cordatae and Rhizoma Smilacis Glabrae was less than 125 mg/mL. The MIC of Fructus Arctii Lappae, Flos Chrysanthemum Mortifolii, Herba Whiteflower Patrinia Herb, Radix Thichosanthis and Fructus Brucae Javanicae was less than 250 mg/mL. The MIC of Calculus Bovis, Fructificto Lasiosphaeraceae, Folium Perilicr Frutescentis, Radix Bupleuri, Caulis Lonicerae, Radix Sophorae Flavscens was less than 500 mg/mL, and the MIC of other medicinal herbs was greater than 500 mg/mL. Authority books, such as Pharmacopoeia of People’s Republic of China (Committee of National Pharmacopoeia, 2005 edition), Chinese Herbal Medicine (Gong-Wang Liu, Li-Ya Gao, 2000, Hua Xia Publishing House), Modern Clinical Chinese Herbal Medicines (Dong Kun-Shan, Wang Xiu-Qin, Dong Yi-Fan, 2001, Chinese Traditional Medicine Press), acclaimed that most selected medicinal plants have an activity against microscopic organisms, including various Gram-negative or -positive bacteria, fungi, viruses or parasites. In fact, many of them are the constituents of Chinese patent medicines used in treatment of stomach discomfort-related diseases. More importantly, most of them demonstrate a significant anti-H. pylori activity.

DISCUSSION

In this study, the MIC in 50 traditional Chinese herbal medicines was detected. Although a considerable variety of plants showing an antimicrobial activity have also been reported in other studies[7-19], variation of MIC still exists due to the bioassay methods employed in different studies, the sources and age of the plants, the solvent used for extraction, and H. pylori strains. The susceptibility of H. pylori SS1 to water extracts was examined and screened in this study with broth dilution diffusion, a quantitative assay method, which is less time-consuming and less labor-intensive than agar dilution method, and cheaper than Etest. All selected herbal medicines are the commonly used traditional Chinese herbal medicines prescribed by physicians of traditional Chinese medicine. Some plants are even recommended as a dietetic therapy for health preserving, such as Radix Isatidis, Herba Houttuyniae Cordatae. More importantly, all the selected herbal medicines have a same standard from the TonRen Corporation. Although the susceptibility of only an isolated H. pylori strain to such medicines was tested, the susceptibility of other clinical strains to these medicines should also be tested.

In this study, the water extract from Rhizoma Coptidis, Radix Scutellariae and Radix Isatidis had a stronger anti-H. pylori activity than that from other plants, indicating that the three plants can be used as useful sources for the synthesis of novel drugs against H. pylori. Traditional medical practitioners and biomedical specialists play an important role in pharmacodynamics and pharmacokinetics research. In order to find scientific evidence and rationalize the utility and efficacy of traditional Chinese medicines, they have tried to extract and analyze the active compounds of medicinal plants with various biomedical analytical techniques and assay methods, and evaluated their antibacterial and anti-inflammatory mechanism in animal experiments.

Rhizoma Coptidis contains berberine. Several protobberine alkaloids of berberine, palmatine, cotispine and aporphinoid alkaloid of magnoflorine have beenconfirmed to be the major pharmacologically active constituents, and these alkaloids demonstrate a significant antimicrobial activity against a variety of organisms including bacteria, viruses, fungi, protozoans, helminthes, and Chlamydia[22,23]. The pharmacological antibacterial activity of the 3 berberine alkaloids is berberine > cotispine > palmatine[24]. An animal experiment suggested that the total alkaloid is a potent protective agent against H. pylori LPS which induces gastric mucosal inflammation[25].

Radix Scutellariae contains over 30 kinds of flavonoid, such as baicalin, bicalaen, wogonin, wogonin7-glucuronide, oxorlyn A, and oxorlyn A 7-O-glucuronide[26]. Active flavonoids, including baicalin, baicalein, wogonin, and wogonoside, have a variety of pharmacological activities, such as anti-inflammation, free radical scavenging and anti-oxidation[27], and antibacterial action[28]. All active flavonoids exert their anti-inflammatory effect mainly by inhibiting the inducible nitric oxide synthase (iNOS) and cyclooxygenase-2 (COX-2) gene expression[29]. It was
reported that Radix Scutellariae inhibits LPS-induced production of proinflammatory mediators, including NO, IL-3, IL-6, IL-10, IL-12p40, IL-17, IP-10, KC, and VEGF in mouse macrophages[34].

Radix Isatidis is also officially documented. Organic acids, including syringic acid, 2-amino-benzoic acid, salicylic acid and benzoic acid among the main chemical active components, have been segregated and purified as a crystal[35]. Some authors have even tested the potency sequence of the 4 organic acids (syringic acid > 2-amino-benzoic acid > salicylic acid > benzoic acid)[32]. Furthermore, the 4 organic acids share a basic molecular structure, and the number, position and type of their functional groups on phenyl ring have great impacts on antibacterial activities. Extracts from Radix Isatidis can decrease the production of inflammatory mediators, such as nitric-oxide, prostaglandin E2, and pro-inflammatory cytokines[36,37].

Traditional Chinese medicines have a long history, due to their effectiveness and relatively low toxicity, and herbal medicines have drawn more and more attention during the past decades. Chemical compositions of Rhizoma Coptidis, Radix Scutellariae and Radix Isatidis have been extensively studied, some of which can act on H. pylori LPS and inhibit the production of proinflammatory mediators. In our study, water extracts from the medicinal plants demonstrated a strong anti-H. pylori activity, and a wide range of phytochemistry materials from medicinal plants could reduce the inflammatory response, indicating that the 3 herbal drugs can be used as anti-inflammatory or anti-bacterial agents. However, the strong in vitro anti-H. pylori activity of these water extracts does not necessarily imply that they have a strong in vivo anti-H. pylori activity. On the other hand, some of these plants may be more potent in vivo due to metabolic transformation of their components into highly active intermediates. However, further study is needed to confirm the effect of Rhizoma Coptidis, Radix Scutellariae, Radix Isatidis and other traditional Chinese medicines on alimentary tract diseases due to H. pylori infection.

It is well known that human beings are the main reservoir of H. pylori. World Health Organization pointed out that most subjects infected with H. pylori have no clinical symptoms, peptic ulceration and superficial chronic gastritis, but peptic ulcer, ulcer complications, and progression to gastric cancer will occur in approximately 17%, 4.25% and 1% of H. pylori-infected subjects, respectively[38]. Besides, extragastric diseases involving the cardiovascular, hepatobiliary, dermatological, immunological, hematological systems[39] are also related with H. pylori infection. Moreover, since H. pylori was isolated from human dental plaque[39], H. pylori has been detected in oral cavity, suggesting that oral cavity diseases such as halitosis, glossitis, burning mouth syndrome, recurrent aphthous stomatitis, dental caries, are related with oral H. pylori infection. Anand et al[37] reported that the prevalence of H. pylori is higher in dental plaque of patients with gastric H. pylori infection than in that of patients without gastric H. pylori. It has been shown that patients with poor oral hygiene have the most frequent recurrence of gastric H. pylori infection[39]. Oral cavity is a potential reservoir of H. pylori and oral H. pylori may influence the relapse of gastric H. pylori infection. It was reported that H. pylori in dental plaque is hardly eradicated by triple therapy[30,31], suggesting that oral antibiotics have almost no effect on H. pylori in oral cavity.

With the better recognition of H. pylori, more diseases have been found to be related to H. pylori. Since oral cavity, as a residence of H. pylori, is as important as stomach, prevention and treatment of oral H. pylori infection should be put on the agenda. Antibiotics have been the main drugs against H. pylori since the bacterium was discovered. Further study is needed to solve the problems such as drug resistance, poor patient compliance, undesirable side effects and the significant cost of combination therapy. Traditional Chinese medicines have shown their advantages over Western drugs, including a lower price, a low toxicity and less adverse reactions.

It is exciting that Rhizoma Coptidis, Radix Scutellariae, Radix isatidis and other herbs with a strong anti-H. pylori activity may provide the potential sources of new drugs, thus reducing the morbidity of oral cavity diseases and improving the eradication rate and relapse of gastric H. pylori infection.

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**COMMENTS**

**Background**

Many diseases are related to Helicobacter pylori (H. pylori) infection. Although antibiotics can eradicate gastric H. pylori, antibiotics treatment can lead the problems, such as drug resistance, poor patient compliance and undesirable side effects. It has been reported that some herbal medicines have an anti-H. pylori activity. The herbal medicine resources are rich in China with a long history of practicing traditional Chinese medicine. However, few studies are available on the anti-H. pylori activity of herbal medicines. Herbal medicines may be potential sources of new drugs.

**Research frontiers**

Human beings are the main reservoir of H. pylori. World Health Organization estimates indicate that H. pylori infection is closely related with gastric and extragastric diseases involving the cardiovascular, hepatobiliary, dermatological, immunological, and hematological systems. H. pylori has been detected in oral cavity. Oral cavity diseases such as halitosis, glossitis, burning mouth syndrome, recurrent aphthous stomatitis, dental caries, may be related with H. pylori infection.

**Innovations and breakthroughs**

In vitro susceptibility test was performed for water extract from 50 selected traditional Chinese herbal medicines and their anti-H. pylori activity was evaluated according their MIC values. The active compounds of Rhizoma Coptidis, Radix Scutellariae and Radix Isatidis, were detected and their anti-H. pylori activity was analyzed.

**Applications**

Since Rhizoma Coptidis, Radix Scutellariae and Radix Isatidis have a strong anti-H. pylori activity, with a low toxicity, a low price and less adverse reactions, they can be used in preventing and treating gastric and/or oral H. pylori infection.

**Peer review**

This study described the strong anti-H. pylori activity of Rhizoma Coptidis, Radix Scutellariae and Radix Isatidis, thus adding some novel herbal medicines for preventing and treating gastric and/or oral H. pylori infection.
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