The Overview: the antimicrobial, antioxidant activities and chemical profile of *Centella asiatica*

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Abstract

According to the draft of Thai herbals development strategic plan; Thailand Champion Herbal Products: TCHP by the department for development of Thai transitional and alternative medicine, Ministry of Public Health, Centella asiatica (Bao-bog, Gotu Kola) is one of the five herbs in champion herbal products. To be able to produce quality herbal products, scientific proven data is needed to increase the confidence and acceptance of consumers, not only local wisdom. The variation in herbal form (fresh and dried), solvent types, and extraction ratio and extraction times could affect the antimicrobial activities, antioxidant activities and chemical profile. Thus that biological active compound compositions, antimicrobial activity, and antioxidant activity profiles would be the important stepping stone for development of medicine industry, food industry, cosmetics industry.

Keywords*: Centella asiatica*, Bao-bog, antimicrobial, antioxidant, chemical profiles

Introduction

The Thai herbals market proved to be big market for investment, according to record in year 2011, the domestic market value of Thai herbals is around 8,000 million baht and for the import-export market value is around 200-300 million baht (ร่างแผนยุทธศาสตร์การพัฒนาสมุนไพรไทย: สมุนไพรไทย-สินค้าโลก พ.ศ. 2556-5560การพัฒนาสมุนไพรไทยสู่ผลิตภัณฑ์สร้างมูลค่าทางเศรษฐกิจของประเทศไทย). In the cosmetic market, the herbal extract, imported as the active ingredients, is mostly from Europe. This import market value is 20,000-30,000 million baht (Department for development of Thai transitional and alternative medicine, 2013). Interestingly, these herbals can be cultivated and processed in Thailand. In the food supplements market, it was found that the herbal extract imported value is around 20,000 baht (Department for development of Thai transitional and alternative medicine, 2013).

On the aspect of a national strategy, the Government wishes to achieve in the completeness of fundamental healthcare, upgrade of healthcare in various areas, and healthcare in terms of tourism, as well as more employment opportunity and development of excellence as a "medical hub" (Thai royal government news room, www.thaigov.go.th). The Government has determined 4 goals for the medical hub development as follows: 1) to become a Wellness Hub with full-cycle health services; 2) to become a Medical Service Hub with spa and medical tourism services that are the country's strengths; 3) to become an Academic Hub with national excellence in medical research and development; and 4) to become a Product Hub of medicines, medical supplies, and health-related products (Thai royal government news room, www.thaigov.go.th). Therefore the department for development of Thai transitional and alternative medicine, Ministry of Public Health had launched the draft of Thai herbals development strategic plan; Thailand Champion Herbal Products: TCHP (ร่างแผนยุทธศาสตร์การพัฒนาสมุนไพรไทย: สมุนไพรไทย-สินค้าโลก พ.ศ. 2556-5560การพัฒนาสมุนไพรไทยสู่ผลิตภัณฑ์สร้างมูลค่าทางเศรษฐกิจของประเทศไทย) as service plan in order to promote Thai medical services; medical hub.

The 5 Thailand Champion Herbal Products (TCHP) are as the following: 1) *Pueraria mirifica* (Kwao Krua Kao); 2) *Zingiber cassumunar* Roxb (Plai, Cassumunar ginger, Bengal root); 3) *Kaempferia parviflora* (Gra Chai dam, Black Ginger); 4) *Centella asiatica* (L.) Urban (Bao-bog, Gotu Kola), and 5) Look Prakab (ลูกประคบ).

The strategy 2 of the draft of Thai herbals development strategic plan is to develop the herbal product with its standard process. In order to produce herbal product with its standard process and to be the medical hub, the scientific proven data is needed to increase the confidence and acceptance of consumers, not just only local wisdom. The biological active compound compositions, antimicrobial activity, and antioxidant activity profiles are the important as stepping stone for development of medicine industry, food industry, cosmetics industry.

C. asiatica, locally called Bao-bog, is one of Thailand champion herbal products proposed in the draft of Thai herbals development strategic plan by the department for development of Thai transitional and alternative medicine, Ministry of Public Health.

C. asiatica (L.) Urban. (Bao-bog, Tiger Herbal, pennywort, gotu kola) is traditional drug formula using stem and leaves, aerial parts to decrease blood pressure, cure the fresh wound, heal bruised and diuretic (Ullah *et al*., 2009). Active compounds in *C. asiatica* compose of various types of Terpenes or Terpenoids (Oyedeji and Afolayan, 2005; Gershenzon and Dudareva, 2007). From the work of Arumugam *et al*. (2011), they found out that different extraction solvents gave different phytochemical compounds.

Antioxidant activities

From the work of Hamid *et al*. (2002), they found out that among three solvent used to extract *C. asiatica* (water, ethanol and light petroleum incubate at 25 ºC for 24 hour in shaker), ethanol show highest antioxidant activities follow by water and light petroleum showed negative antioxidant activities. Chanwitheesuk *et al*. (2005) found out that using methanol as extraction solvent soak *C. asiatica* overnight at room temperature possess antioxidant activities within. The levels of phenolic and flavonoid compounds of *C. asiatica* aqueous extract were 2.86 g/100 g and 0.361 g/100 g, respectively (Pittella *et al*., 2009). *C. asiatica* aqueous extract had a promising activity against mouse melanoma (B16F1), human breast cancer (MDA MB-231) and rat glioma (C6) cell lines, with IC_{50} values of 698.0, 648.0 and 1000.0 µg/mL, respectively (Pittella *et al*., 2009). The *C. asiatica* ethanolic extract showed 100% free radical inhibition at 400 mg/ml concentration using DPPH (1,1-diphenyl-2-picryl hydrazyl) Free Radical Scavenging Assay (Jacob and Shenbagaraman, 2011). The *C. asiatica* water extracts showed the antioxidant activity using Thiobarbituric Acid (TBA) assay (Huda-Faujan *et al*., 2007). It was found out that *C. asiatica* has strongest DPPH (1,1-diphenyl-2-picryl hydrazyl) radical scavenging activity and highest total antioxidant capacity as gallic acid and ascorbic acid equivalent among the eleven edible Indian green leafy vegetables (Dasgupta and De, 2007). *C. asiatica* meathanolic extract showed higher level of antioxidant activity among the 20 traditional leafy vegetables cultivated in South Africa (Odhav *et al*., 2007). The n-hexane, carbon tetrachloride and chloroform soluble fractions of methanol extract of the *C. asiatica* also showed antioxidant activity (Ullah *et al*., 2009).

Antimicrobial activities

It has been reported that *C. asiatica* 95% ethanol crude extract against *Bacillus cereus* and *Listeria monocytogenes* under normal, osmotic stress, and low pH (Pitinidhipat and Yasurin, 2012; Utami *et al*., 2012). It was found that ethanolic *C. asiatica* extract possess activity against enteric pathogens (Mamtha *et al*., 2004). Methanol, acetone, chloroform and water extracts of leaf and callus were evaluated for in vitro antibacterial activity against

Table1: The antimicrobial activity, antioxidant activity, and biological active compounds

Anti-microbial Activity	Anti-oxidant Activity	Biological Active Compounds	References
√			Mamtha *et al*., 2004
√		Alkaloid Glycosides Terpenoids Steroids Flavonoids Tannins	Arumugam *et al*., 2011
√			Pitinidhipat and Yasurin, 2012; Utami *et al*., 2012
	√		Jacob and Shenbagaraman, 2011
√			Zhang *et al*., 2011
√			Dash *et al*., 2011
√			Na Phatthalung *et al*., 2012
√			Sankar *et al*., 2010
	√		Pittella *et al*., 2009
	√		Ullah *et al*., 2009
√		Saponins, phytosterols, phenolic compounds, tannins, and terpenoids	Kannabiran *et al*., 2009
	√		Huda-Faujan *et al*., 2007
	√		Dasgupta and De, 2007
	√		Hamid *et al*., 2002
	√		Chanwitheesuk *et al*., 2005

B. cereus, *Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa* show antimicrobial activity (Arumugam *et al*., 2011). The *C. asiatica* crude extract (250 µg/ml) in combination with novobiocin (1/8xMIC) possess activity against *Acinetobacter baumannii* ATCC 19606 (Na Phatthalung *et al*., 2012). However, both crude aqueous and ethonalic extracts at 200mg/ml did not showed antibacterial activity against *E.coli* (MTCC-443), *Klebsiella pneumonia* (MTCC-109) and *Staphylococcus aureus* (MTCC-96) (Jacob and Shenbagaraman, 2011). The extracts of *C. asiatica* were found to be effective antibacterial activity against human pathogens and antifungal activity under different extraction condition (Dash *et al*., 2011). The petroleum ether, ethanol, chloroform, n-hexane and aqueous crude extracts against *P. vulgaris*, *S. aureus*, *B. subtilis* and *E. coli*, expect n-hexane doesn't have antibacterial activity against *E. coli* whereas all crude extract against two fungi; *Aspergillus niger* and *Candida albicans* (Dash *et al*., 2011). The 50 mg/ml *C. asiatica* crude aqueous, methanol, acetone and ethyl acetate extracts show antibacterial activity against *S. aureus* (ATCC 700699), *E. coli* (ATCC 10412), *P. aeruginosa* (ATCC 27853) and *K. pneumoniae* (ATCC 2719) (Kannabiran *et al*., 2009). And the 50 mg/ml *C. asiatica* crude methanol and ethanol show antifungal activity against *A. fumigatus*, and *A. niger* (Kannabiran *et al*., 2009). Saponins, phytosterols, phenolic compounds, tannins and terpenoids were found as major phytochemicals of *C. asiatica* aqueous extracts (Kannabiran *et al*., 2009). The 80% ethanolic crude extracts showed antibacterial activity against *E. coli*

O157:H7, *S. typhimurium*, and *L. monocytogenes* at all different concentrations; 5, 10, 20, 40 mg/ml (Zhang *et al*., 2011). The *C. asiatica* ethanolic extract showed antibacterial activity against 3 *Vibrio* species named *V. harveyi*, *V. alginolyticus* and *V. parahaemolyticus*. But acetone, chloroform and hexane extracts did not show antibacterial activity against these species (Sankar *et al*., 2010).

However, there is no research about varying the maceration times, extraction solvent ratio between herbs and solvent, compare between fresh and dried form *of C. asiatica* and solvents such as autoclaving with water, boiling with water extraction as Thai traditional method, fresh crush or using 40% v/v white spirit. As mentioned, those solvents some of them have been used locally to produce traditional medicine. Thus that, there still lacks of the chemical profile, antimicrobial and antioxidant activities of purposed extraction conditions which base on Thai local wisdom that could fill in the gap between local wisdom and scientific fact.

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