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Mini Review

Thunbergia laurifolia, a traditional herbal tea of Thailand: botanical, chemical composition, biological properties and processing influence

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Abstract

This review aims to compile biological activity including antioxidant, anti-microbial, and anti-inflammatory properties of *Thunbergia laurifolia* or Rang Jued in Thai. Thais has been using this plant as folk medicine since ancient times. *T. laurifolia* is recognized mainly for its detoxification property, however, recently anti-inlammatory, antioxidant, anti-microbial, hepatoprotective and anti-diabetic are also more addressed. Consumption of *T. laurifolia* is normally in the form of herbal tea or fresh leaves. This review also provides basic botanical knowledge, chemical composition, medicinal effect of *T. laurifolia* and factors affecting the herbal tea process.

Introduction

It is well known that an increase of pesticide usage in agriculture country as Thailand, Vietnam, China etc. is becoming a serious problem (Grovermann *et al*., 2013). The heavy use of pesticide leads to residue problem in the ecosystem including soil, sediment, water, aquatic life and agricultural products. Therefore, humans who are at the top of food chain face with adverse health effects (Sapbamrer *et al*., 2011). Though organic farming is increasing, yet environmental pollution is still seriously worldwide. Detoxification is attempted to reduce causes of illness particularly non-communicable disease such as obesity, cancer, heart failure, kidney disease and hypertension (Sheehy and Sharma, 2010) which involved with chemical contaminated food consumption besides less exercise.

Thunbergia laurifolia or Rang Jued, a local Thai plant belongs to the Acanthaceae family is commonly consumed in the form of herbal tea and widely used by Thai folk medicine which is considered important for public health. Fresh and dried forms of this plant as leaves, barks and roots are mainly used as an antidote for insecticide, drug, arsenic, strychnine, alcohol, treating food poisoning and chemical toxic (Thongsaard and Marsden, 2002; Oonsivilai, 2006; Inta *et al*., 2013; Rocejanasaroj *et al*., 2014; Maneenoon *et al*., 2015). Product of *T. laurifolia* in Thailand's market is normally in tea, capsule and powder forms. Dried and ground leaves packed in the tea bag will be steeped in hot water for making the tea (Chan *et al*., 2012; Singtonat and Osathanunkul, 2015). People who suffer from drugs, alcohol and cigarettes addiction are advised or prescribed by Thai medical doctors (Chan and Lim, 2006; Chan *et al*., 2011). The objective of this article is to provide an overview of scientific data on botanical, active compound, biological properties and processing effect of *T. laurifolia.*

Botanical description

In Thailand, *T. laurifolia* has several names including Rang Jued, Yaw Kaew, Kob Sha Nang, Gum Lung Chang Puak, or Krua Nan Nae in the North (Aritajat *et al*., 2004). It is a climbing plant with smooth opposed leaves along the stem. The leaves are 8-10 cm long and 4-5 cm broad, broad-based, narrowing to a pointed tip, usually with scalloped lobes towards the base (Figure 1). The characteristic of *T. laurifolia* flower is show in Figure 2. The flowers are trumpet-shaped and the seed pod is cone-shaped, 1 cm long, with a round base. The purple flower cultivar has been reported to have several distinct pharmacological properties particularly from extracts derived from stems, roots and leaves (Oonsivilai, 2006).

Chemical composition and some active compounds

The content of fibre, ash, protein, fat, and carbohydrate on dry basis weight of *T. laurifolia* leaves was 16.82, 18.79, 16.70, 1.68 and 46.01%,

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(a) (b)

Figure 1. Characteristic of *Thunbergia laurifolia* leaves in Thailand; young leaves (left), developing leaves (middle), and mature leaves (right); (a) dorsal side and (b) ventral side of leaves

respectively (Jaiboon *et al*., 2010). The phytochemistry of the leaves consists of 5 group (Chuthaputti, 2010) (1) sterols such as beta-sitosterol, stigmasterol, alphaspinasterol (2) phenolics such as apigenin, caffeic acid, gallic acid and protocatechuic (Chuthaputti, 2010; Oonsivilai *et al.*, 2007) (3) carotenoids such as lutein (Chuthaputti, 2010), (4) unclassified steroids (Chuthaputti, 2010) and (5) glycosides such as 8-epi-grandifloric acid, 3'-O-β-glucopyranosyl-stilbericoside, grandifloric acid, benzyl β-glucopyranoside, benzyl β-(2'-O-β-glucopyranosyl)-glucopyranoside, 6-C-glucopyranosyl apigenin, 6,8-di-C-glucopyranosyl apigenin, (E)-2-hexenyl-β-glucopyranoside, and hexanol-β-glucopyranoside (Kanchanapoom *et al*., 2002; Chuthaputti, 2010; Chan *et al*., 2011). Though, the leaves of this plant are the main part of utilization, bark and root are also used (Thongsaard and Marsden, 2002). Some studies on *T. laurifolia* leaves in particular functional properties which is related to human health benefit are the followings.

Biological effects of leaves

Anti-inflammatory effects

For more than 30 years, preclinical and clinical researches have been investigated to prove anti-inflammatory effects in *T. laurifolia* leaves (Chuthaputti, 2010). The anti-inflammatory efficiency dose of the aqueous leaves extract of T. laurifolia (2.5 g/kg) has been reported to be two-fold higher than that of *Garcinia mangostanarind* rind extract (5.5 g/kg) with carrageenan induced paw edema model in mice (Pongphasuk *et al.*, 2005). Moreover, Wonkchalee *et al.* (2012) reported that *T. laurifolia* possessed anti-inflammatory and antioxidant properties which improved liver function in hamsters treated with liver fluke infection or after administration of N-nitrosodimethylamine (NDMA, a potent hepatotoxin, carcinogen and mutagen). The research found that fresh and dried aqueous

Figure 2. Characteristic of *Thunbergia laurifolia* flower in Thailand

extract from *T. laurifolia* leaves clearly reduced the inflammatory cells treated with *O. viverrini* , a human liver fluke which is the primary risk factor for cholangiocarcinoma, reduced NDMA-administered groups of Syrian hamsters. The anti-inflammatory activity of the plant extracts were well correlated with the total antioxidant capacity. Additionally, Boonyarikpunchai *et al*. (2014) reported rosmarinic acid, isolated from an ethanolic extract of *T. laurifolia* leaves (Suwanchaikasem *et al*., 2014) has anti-inflammatory effects against acute and chronic inflammation.

Antioxidant effects

It was found that aqueous extraction of *T. laurifolia* leaves had higher total phenolic content (TPC) compared to ethanol and acetone extract (Oonsivilai, 2006). Moreover, the aqueous extract also yielded the highest free radical scavenging (DPPH) with EC_{50} value and FRAP compared to ethanol and acetone extracts (Oonsivilai, *et al*., 2008; Chan *et al*., 2011). Furthermore, Chan *et al*. (2013) reported that the developing leaves had the highest TPC of 513 mg GAE/100 g, followed by young and mature leaves with values of 407 and 298 mg GAE/100 g, respectively. High TPC and free radical scavenging activities of *T. laurifolia* extract has been stated to relevant against human breast cancer cells (Jetawattana *et al*., 2015) and protects hemolysis in mice during *Plasmodium berghei* infection, caused of malaria, through the inhibition of oxidative stress (Khobjai *et al*., 2014).

Anti-microbial effects

The pharmacological property of *T. laurifolia* has also been reported to process antimicrobial activity including antibacterial, antifungal and antiviral. Pukumpuang *et al*. (2012) reported the ethanolic extracts from *T. laurifolia* showed inhibition clear zone activity on *Staphylococcus aureus*, methicillin resistant *Staphylococcus aureus* (MRSA), *Staphylococcus epidermidis* and *Streptococcus pyogenes*. While, aqueous extract

of this plant can inhibit MRSA and *Streptococcus pyogenes*, ethanolic leaf extract, showed inhibition of *Bacillus subtilis* under induced with UV light but not for *Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Candida albicans*, and *Aspergillus fumigatus* (Cheeptham and Towers, 2002; Chan *et al*., 2011). Wirotesangthong *et al.* (2009) reported that the aqueous leaves extract showed neuraminidase (NA) inhibition in the influenza viruses, including type A (H1N1 and H3N2) and B. Moreover, Tewtrakul *et al.* (2003) addressed that the ethanolic and water extracts of leaves showed mild anti-HIV virus by inhibited HIV-1 integrase even less effectively.

Hepatoprotective activity

Several data reported the aqueous extract of the leaves possessed hepatoprotective activity. In rats treated with ethanolic extract protected mice from hepatic disorder induced by ethanol. Moreover, the hepatoprotective activity of aqueous extract of the leaves against ethanol which can induce liver injury in rats and in primary cultures of rat hepatocytes has also been reported (Chanawirat *et al*., 2000; Pramyothin *et al*., 2005; Oonsivilai, 2006; Chan *et al*., 2011).

Anti-diabetic effect

Taking the aqueous leave extract as 60 mg in 1 ml/day for 15-day showed a decrease level of blood glucose and recovery of some β-cells was found in diabetic rats. The result explained that the leaf contained insulin-like substance(s) which directly acts as hypoglycemic agents, or some substances that induce the regenerative process of β-cells (Aritajat *et al*., 2004; Chan *et al*., 2011).

Detoxifying effect

Morkmek *et al*. (2010) reported the effects of the aqueous leaves extract on detoxification of cadmium in rat. It was found that abnormal appearance and behavior was lesser in rats fed with the extract prior to cadmium exposure than in those fed with the extract after cadmium exposure. Therefore it may be concluded that the leaf extract reduced some effects of cadmium toxicity. Furthermore, Phyu and Tangpong (2013) showed that the aqueous leaves extract significantly prevented Pb induced neurotoxicity in a dose-dependent pattern which was indicated by comparatively better performance of treated mice. Amount of phenolic content, antioxidant and neuroprotective properties increased along with the concentration of *T. laurifolia* extract. The detoxifying effect of the aqueous leaves extract on paraquat was reported by Usanawarong *et al*. (2000) who addressed that the aqueous leaves extract can detoxify against paraquat-intoxicated rat by decreasing plasma malonaldehyde, an indicator of lipid peroxidation of paraquat-intoxicated rat. Moreover, Chinacarawat *et al.* (2012) suggested that orally administered *T. laurifolia* capsule at the dose of 600 mg/day for 2 weeks continuously can reduce organophosphate and carbamate insecticide poisoning and had no side effects in high risk volunteer.

Table 1. Total phenolic content (TPC) and ascorbic acid equivalent antioxidant capacity (AEAC) of tea infusions of *Thunbergia laurifolia* in comparison with the commercial tea (dry weight)

Tea infusion	TPC (mg GAE/100 g)	AEAC (mg AA/100 g)
Freeze-dried	3850 ± 127[a]	4520 ± 100[a]
Microwave-dried	3080 ± 202[b]	3450 ± 273[b]
Oven-dried	1800 ± 57[c]	1590 ± 55[c]
Commercial tea	577 ± 39[d]	398 ± 22[d]
Freeze-withered	488 ± 44[e]	219 ± 63[e]

[a-e] Means within a column with different letters are significantly difference ($p<0.05$). TPC and AEAC are means ± SD (n = 3).
Abbreviations: GAE = gallic acid equivalent and AA = ascorbic acid.
Source: Chan *et al.* (2011)

Processing factors affecting

Normally, *T. laurifolia* is generally used as herbal tea product. Drying process serves as an essential part of tea processing, influence to its antioxidant content and appearance which affects the commercial value of the tea (Chong and Lim, 2012). Chan and Lim (2006) reported that using a household microwave oven for drying Thunbergia leaves possessed higher total phenolic content, and antioxidant activity measured by DPPH, FRAP and ferrous ion chelating (FIC) assays compared with conventional oven-dried and sun-dried as well as fresh leaves. Moreover, the finding of Chan *et al.* (2011) addressed the effects of various thermal and non-thermal drying methods on the antioxidant properties of leaves and teas of *T. laurifolia* which showed remarkable differences. The information of the research was set up as the leaves (15 g) were shredded, and divided to microwave-dried (1.5 min), oven-dried (3 h), freeze-dried (overnight), and freeze-withered (2 h). Then the treated leaves were extracted by steeping in hot water (1 h) to obtain the tea infusions. The result revealed that using microwave was a great choice to process

the *T. laurifolia* tea as shown in Table 1. However, Mahasarakul *et al*. (2013) found that free radical scavenging activity of *T. laurifolia* beverage which prepared from sun dried leaves and vines boiled in hot water and stored at 4ºC in closed packaging decreased significantly when increased storage time.

Conclusion

Thunbergia laurifolia, particularly the purple flower type is widely consumed in Thailand, especially in the form of herbal tea. Its phytochemistry includes 5 groups; sterols, phenolics, carotenoids, steroids and glycosides which exhibit biological properties. The biological effects such as anti-inflammatory, antioxidant, anti-microbial, hepatoprotective, anti-diabetic and detoxifying effects are being focused. As the process of making tea influencse the quality and bioactive compounds, scientific research will be useful for making the best *T. laurifolia* tea which is now popular.

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