Medicinal and Phytochemical Properties of Selected Herbal Plants in Central China and Western Visayas, Philippines

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ABSTRACT

This investigation was conducted to evaluate the medicinal and phytochemical properties of four selected herbal plants: *Andrographis paniculata, Cassia obtusifolia, Leonurus japonicus* and *Pueraria lobata* found in both Central China and Western Visayas, Philippines. Mixed method research design was employed, the quantitative on herbals' descriptions and phytochemical analysis, while qualitative on interview of traditional healers. The herbals were identified and authenticated by the research team. The phytochemical analyses used the methods: Extraction of plant parts, Thin Layer Chromatography, UV identification and High-Performance Liquid Chromatography. The bioactive compounds diterpenoid dehydroangropholide in *A. paniculata* supports the claim of local healers to treat stomach ache and diabetes; the terpenoid orange cassia and chrysophanol in *C. obtusifolia* seeds supports the treatment for ulcer, hepatitis or liver associated ailment, ringworm, scabies and psoriasis; the alkaloid leonurine hydrochloride in *L. japonicus* leaves supports the healing practices in treating menstrual disorders and fever; and the flavonoid puerarin in *P. lobata* tubers supports the claim of traditional healers in regulating menstruation, diuresis, fever and promotes blood circulation. Most healing practices in both study areas have scientific explanations.

Keywords: Science, medicinal, phytochemical properties, local healers, Bioactive compounds, treatment, healing practices, Central China and Western Visayas, Philippines.

Introduction

Due to modernization, people nowadays are more integrated into mainstream society (Morilla, 2014) which is a threat in passing ethnomedicinal knowledge and practices. Since, many of the plant knowledge learned from our ancestors were transferred orally (Talkmore et al., 2015), it needs a continuous documentation to conserve oral custom and support local health care (Mesfin, et al., 2013) because it is the foundation for many of the medicinal remedies which we are now using and hold answers to cure several diseases in the future (Gutierrez, 2013).

For a long time, traditional medicine had been marginalized in the health planning of developing countries. However, in the last twenty years there has been a major revival of the traditional system of health care (Peltzer and Pingped, 2015). Every region, at one time in history, had a form of traditional medicine. Plant-based medicines still play an important role in the primary healthcare of 80% of the world's population in both underdeveloped and developed countries (Dey et al., 2013). This traditional medicine is deeply rooted in a specific socio-cultural life which varies from one community to another. Each community has its own approach to health care and cure of disease even at the level of entomopathogenic perceptions of diseases and therapeutic behavior. In this respect, we can argue that there are as many traditional medicines as there are in communities. Hence, traditional medicine is diverse and pluralist in nature.

A Survey of Ethnopharmacology of Medicinal Plants in Iloilo, Philippines (Tantiado, 2015), revealed that the number of medicinal plants (n=101 species) and their uses in the community demonstrate the depth of the local knowledge on indigenous medicinal plants and their applications. Findings pointed out that the use of more plant leaves than other plant parts implies that traditional medical culture in the area does not threaten biological diversity. Similarly, Malawani et al. (2017) revealed that medicinal plants were found to treat a range of health problems from simple wounds to diseases and even cancer. Plant leaves were the most utilized through the decoction process.

Objectives of the Study

The main purpose of this study was to evaluate the medicinal and phytochemical properties of selected herbal plants in Central China and Western Visayas, Philippines. Specifically, this study aimed to identify and compare the herbal test plants according to plant parts used in the treatment of ailments, mode of preparations of medicinal plants, type of application and ailment treated; and to characterize the phytochemical properties of herbal plants.

Methodology

This study is a descriptive research, a combination of both qualitative and quantitative research approaches. The descriptive approach was used on the survey of

herbals , collection and identification. The phytochemical analysis was the experimental part of the study. Medicinal uses and healing practices were accounted for the qualitative part.

Purposive sampling technique on selecting the four species and in the identification of local healers was employed.

Test plant samples were leaves of *A. paniculata* Burm. f. and *L. japonicus* Houtt eeds of *C. obtusifolia* L. (Roxb.), and tubers of *P. lobata* (Willd.) Ohwi. The researchers validated the test plants and were both present in China and Philippines.

Local healers in Western Visayas (WV), Philippines and Central China were identified because of their known healing practices in their community. Consent form was filled up before the conduct of a voluntary face to face interview using the semi-structured questionnaire. The questions were based on the objectives as on how the plant parts were used in the treatment of ailments, what was the mode of preparation on their healing practice, how was it applied or administered to their patient, and identified a kind of ailment or disease treated.

Phytochemical analyses used dried and powdered herbal plants performed in the laboratory of the College of Pharmacy and Chemical Engineering, ZUIT, Henan, China. The methods in the determination of bioactive compounds in plants samples were series of eextraction using different solvent, Thin Layer Chromatography (TLC), Uultraviolet (UV) Identification and, High Performance Liquid Chromatography (HPLC).

Results and Discussion

Andrographis paniculata Burm. f.

Description. *A. paniculata* is a small evergreen erect shrub with whorled branches and milky sap. The leaves are opposite, entire, oblong-elliptic, up to 30 centimeters long and tastes bitter. The flowers are white, clustered in axillary cymes, with slender corolla tube and 5 spreading lobes. The fruit are small drupe, shiny, black or purple and can be propagated by seeds or stem cuttings. This plant is commonly known as serpentina.

Medicinal practices. Chinese local healers revealed that the leaves of *A. paniculata* were used to treat diuresis, uterine contraction and rheumatism by drinking the decocted parts. The roots and stems were prepared as beverage to treat menstrual pain and profuse bleeding, and rheumatic fever. In the Philippines, the leaves prepared through infusion was drank to treat stomach ache and diabetes while the fruits prepared by decoction used for stomach ache only.

Phytochemical analysis. TLC result of dried powdered leaves of *A. paniculata* revealed the specific shift value was consistent with andrographolide and dehydroandrographolide in water extraction, alcohol extraction, ultrasound. The specific shift value was consistent with dehydrating andrographolide in water extraction and alcohol precipitation, 0.01% alkali acid precipitation, and 0.04% alkali acid precipitation. The dehydrated andrographolide content obtained by ultrasonic method was the highest,

0.853%. *A. paniculata* was more reasonable and scientific using ultrasonic methods and 0.01% sodium carbonate alkaline water reflux extraction process.

The main bioactive components of *A. paniculata* were diterpene lactones and flavonoids, however, andrographolide and dehydroandrographolide have the most pharmacological effects. The test applied to the identification of dehydroandrographolide in *A. paniculata* was through TLC, UV analysis and content determination research, to provide technical reference for the quality control of herbal.

The study of Widjajakusuma et al. (2019) supports the use of Philippine local folks on the healing practice by drinking the leaves of *A. paniculata* prepared through infusion that it can treat diabetes. The andrographolide shows hepatoprotective (Mishra et al., 2017) against various types of liver damage in which the liver is directly affected when a person diagnosed with diabetes (Widjajakusuma et al., 2019; Fitrawan et al., 2019).

Consequently, the plant was traditionally used treating common colds, diarrhea, fever due to several infective cause, jaundice, as a health tonic for the liver and cardiovascular health, and as an antioxidant (Hossain et al, 2014). This also supports the Chinese report on *A. paniculata* that decoctioned roots and stems were used to treat a person with rheumatic fever. Further, the analgesic activity of androgapholide was weaker than aspirin while antipyretic activity was comparable to that of aspirin (Hidalgo et al, 2005).

In addition, Filipino local folks claimed that *A. paniculata* was used to treat stomach ache. However, it was a general ailment caused by various bacteria or other factors. Gupta et al., (1990) reported that *A. paniculata* has an efficient antidiarrheal activity against *Escherichia coli* associated diarrhea. Andrographolite exhibited similar activity to loperamide. In related study, Tanagkul and Chaichantipayut (1985) stated that patients with acute diarrhea and bacillary diarrhea responded favorably to *A. paniculata* as well.

Modern pharmacological studies shown that *A. paniculata* also has anti-cancer (Grace et al., 2019; Wang et al., 2019; Liu et al., 2019), anti-viral (Divyadarshini et al., 2019; Wang et al., 2019; Chen et al., 2019), and anti-tumor (Gu, 2017) properties. These scientific studies found out that *A. paniculata* to treat the diseases mentioned by local healers.

Whatever parts of plants used, contain andrographolide (Jarukamjorn & Nemoto, 2008), maximally in the leaves (>2%). Reported by Pannosian et al., (2000), supports the mode of application by drinking the extracts through decoction and infusion rather than when orally consumed. In addition, the practice of decoction and infusion were effective as andrographolide is abundant in leaves and can be easily isolated from the crude plant extracts as crystalline solid (Chao & Lin, 2010).

The andrographolide appears to accumulate in organs throughout the viscera and quickly absorbed and extensively metabolized in rats and humans. Jarukamjorn and Nemoto (2008) also reported that andrographolide can be eliminated from the human system within 48 hours.

Cassia obtusifolia (L.) Roxb.

Description. This plant is an erect herb or shrub 0.6–2.5 m high. The leaves are about 5–13 cm long, with a cylindrical gland between each of 1–2 pairs of leaflets; stipules linear and leaflets 3 pairs, obovate, subglabrous to pubescent. The flowers are 1-2, generally very short axillary peduncles; pedicels 1.5–3.5 cm long. Sepals rounded at apex. Petals yellow, obovate, 1–2 cm long. Stamens are 3 lower ones longest with the anthers narrowed into a neck towards their tips, 4 somewhat smaller and 3 very small. Fruits are pods linear, straight, or curved, slightly angular in section, dehiscent, glabrescent. Seeds many, longitudinally arranged, brown, subrhombic or ovoid, with a very narrow areole on each face.

Medicinal practices. Chinese local healers used leaves, seeds and whole plant for decoction or infusion. Among their healing practices, drinking the extracts were found to be effective to treat ulcer, intestinal disorder, hepatitis, stomach ache, and edema associated with liver problem. Prepared as poultice and paste, it was applied on ringworm's skin infected. The Filipinos used *Cassia* leaf extracts by pounding and squeezing to treat wounds, insect bites, and dog bites but no readings to support this practice.

Phytochemical analysis. The separation effect of orange-yellow cassia and the impurity peaks in the test solution was good, and the retention time of the orange-yellow cassia reference substance was 13.200 min, which was similar to the retention time of the orange cassia for the test sample (13.384 min). The sample contains orange cassia ingredients. The orange cassia has a good linear relationship with the peak area in the range of 0.011-0.088 mg/mL (R2=0.9488), and the content of orange cassia in cassia seed is 3.454%; the linear range of chrysophanol is 0.0294~0.0588mg/mL(r>0.9999), the content of chrysophanol in the crude extract of Cassia was 17.8%. The Chinese Pharmacopoeia (2015 edition) stipulates that Cassia calculated according to the dry product, and the orange cassia ($C_{17}H_{14}O_7$) should not be less than 0.080%. The experimental content was higher than the Pharmacopoeia. The content of chrysophanol in *Cassia* was much higher than the requirement of chrysophanol in *Cassia* in the Chinese Pharmacopoeia (2015 edition), which was not less than 0.12%. The experimental results were ideal. The extracted compounds were orange cassia, a kind of terpenoid compound, and chrysophanol.

In general, terpenoids exhibit toxicity against a variety of tumor cells (cancer preventive) as well as anticancer efficacy in preclinical model (Thoppil and Bishayee, 2011). Based on interviews of both local healers in Central China and Philippines the *Cassia* as anticancer was not used.

Furthermore, Prateeksha et al. (2019) reported recent advances that chrysophanol pharmacological properties include hepatoprotective (Jiang et al., 2016; Qian et al., 2011), anti-inflammatory, antiulcer, neuroprotective (Lin et al., 2015; Chae, 2017) and antimicrobial activities. This supports the healing practices of Chinese and Filipinos who used the extracts of cassia to treat ulcer, hepatitis or liver associated ailment, ringworm, scabies and psoriases. In the study of Suleyman (2004) stated that chrysophanol and its rich extract medicinal plants significantly protect against gastrointestinal effects of cold-resistant ulcer, alcohol, aspirin, and pyloric ligation-induced ulcer in rats. This supports

the claim of Chinese that by drinking decocted leaves treated ulcer and stomach ache as claimed by Filipinos.

In addition, chrysophanol exhibits antidiabetic activity (Choi et al.,2005). On the review of Arvindekar et al. (2015) , he also reported that chrysophanol has potential to lower blood glucose level up to 150 mg/dL. However, there are many studies asserting the need for validation of chrysophal potency.

The medicinal value of *cassia* was more extensive. Many scholars have done a lot of research on the pharmacological effects of cassia antibacterial, antifungal and experimented in rats.

Leonurus japonicus Houtt.

Description. This plant is annual or biennial herb. The taproots are dense and fibrous rootlets. Stems are erect, 30-120 cm, nodes and angles densely strigose. Leaves are petioled, stem leaves 0.5-3 cm, narrowly winged at apex. The lower stem leaf blades ovate, base broadly cuneate, lobes blong-rhombic to ovate, 2.5-6 × 1.5-4 cm, pinnately divided, adaxially strigose, abaxially pilose, glandular; mid stem leaf blade rhombic, lobes oblong-linear, base narrow cuneate. The flowers are verticillasters -15-flowered, 2-2.5 cm in diameter; floral leaves subsessile, linear to linear-lanceolate, entire or dentate; bracteoles spiny, shorter than calyx, approximately 5 mm. Fruits are brownish, oblong, triquetrous nutlet, approximately 2.5 mm long, base cuneate, apex truncate, smooth. This plant is commonly known as motherwort.

Medicinal practices. Local healers interviews revealed that *L. japonicus'*leaves and shoot were parts used to treat ailments. In China, fresh leaves were applied as poultice on wounds as to activate blood and promote clotting while in the Philippines, the leaves were pounded and squeezed on the head of a person with fever. In addition, leaves were wrapped with banana leaves, heated through the flame and the extracts were wiped over the aching stomach. In similar manner, this also was applied on women who suffered dysmenorrhea or with menstrual problem.

In China,the shoot of *L. japonicus was* used to treat menstrual problem and related obstetrical and gynecological illness that uses traditional medicine by drinking the decoction with Xianaogen, Dangui, Chishao. The decoction was applied externally or was taken orally to treat related urinary problems like leukuria, dysuria and edema.

Phytochemical analysis. Determination of leonurus hydrochloride in samples shows the reference spectrum of the reference substance a peak at 3.151 minutes under the above chromatographic conditions. Using standard curve method, the peak area of samples was determined according to the retention time of reference material of leonurine hydrochloride, and the content of leonurine hydrochloride in samples was calculated. Among the 7 different extraction methods, the content of leonurine hydrochloride extracted by acid ethanol reflux extraction is the largest, which is 0.282mg/g.

Results showed that motherwort hydrochloride had a good linear relationship in the range of 0.06~0.12mg/ml. The results showed that the content of total alkaloid and

alkaloid extracted by reflux extraction with 95% ethanol solution of 0.1% hydrochloric acid is the highest, 0.214% and 0.282mg/g respectively, and there were few impurities in the sample, which as conducive to enrichment. This may be due to the existence of guanidine groups in the alkaloid structure of motherwort, which makes it easy to change from acid to salt. Therefore, it has greater solubility in acidic ethanol solution and higher extraction rate. This work provides a basis for the development of traditional Chinese medicine preparation of motherwort and further research on its pharmacological effects. In this study, the leaves of the herbal plant were used in the phytochemical analysis. The chemical constituents of motherwort are relatively complex, including alkaloids, flavonoids, diterpenes, volatile oils, polypeptides, etc. (Liu et al., 2012).

Leunorine hydrochloride (LH) as the bioactive compound of *Leonurus* was also reported in the study of Mao et al., (2015), that LH significantly inhibited the proliferation of H^{292} cells in a time- and dose-dependent manner, and induced G_0/G_1 cell-cycle arrest. Their study revealed that on non-small cell lung cancer, LH was considered to have antitumor roles. In addition, LH may be a potential feed additive with dual efficacy as an anti-inflammatory and antioxidant agent when tested on broiler chicks (Yang et al., 2019; Liu et al.,2012;). This supports the study on the use of motherwort to treat edema. Motherwort has the functions of promoting blood circulation and regulating menstruation, diuretic and detumescence, clearing heat and detoxifying, and is known as "blood medicine" and menstruation" (Luo et al. 2018).

Moreover, in some treatment using motherwort, modern pharmacological studies have shown that *Leonurus* has protective effects on the nervous system (Hemmati et al., 2019; Liu et al., 2018; Hong et al., 2015), cardiovascular system (He et al., 2018; Lemieszek et al., 2019), kidney (Cheng et al., 2015), as well as anti-cancer (Marta et al., 2019; Miyake et al., 2019, Shamekhi et al., 2019), anti-inflammatory (Azziz et al., 2019; Li et al., 2018), anti-diabetes (Zhou et al., 2018), anti-osteoporosis (Zhang & Tian, 2015) and inhibiting pancreatic lipase activity (Zhao et al., 2019). But these functions were not observed in traditional practices simply.

Pueraria lobata

Description. *P. lobata* is a large woody climber, stems to 30 m long by 2·5(−10) cm diameter. Leaves are trifoliolate. One or two viable seeds are produced per cluster of pods. The hard-coated seeds can remain viable for several years and can successfully germinate only when soil is persistently soggy for 5-7 days, with temperatures above 20°C (68°F). The roots are classified as tubers. The leguminous wild kudzu plant can be seen everywhere in most places of China and Philippines because they survive in moist environments. Kudzu root generally grows in humid environments such as on hillsides, grasslands and roadside.

Medicinal practices. The traditional healing practices' data showed that Chinese utilized both shoots and leaves as herbal while the Filipinos it was not commonly used except in one locality of the region. Kudzu in China was applied to treat diuresis, uterine contraction, rheumatism by drinking decocted shoots. At present, the healing practice is still employed by the local folks. In addition, leaves were ingested raw to treat menstrual pain, profuse bleeding and, rheumatic fever. Leaves infusion served as beverage for

person with diabetes and suffered dizziness. The roots of kudzu were eaten raw by the local folks for they believe that it gave them good health condition. In the Philippines, kudzu leaves were pounded and applied as poultice to treat skin diseases and boils. The stems were chopped and decocted prepared for the women who newly delivered a baby. An aliqout of liquid was given to a mother to drink while the remaining decocted used for steam bathing to prevent or treat post-partum fever. Lastly, preparing a concentrated decocted kudzu plant, a person suffering from stomach ache may drink one glass a day while with diabetes or headache, a glass every three hours was recommended.

Phytochemical analysis. The total flavonoids of radix puerariae were extracted by ultrasonic method. Column chromatography was used to optimize the factors affecting the separation and purification of flavonoids in radix puerariae. By ultraviolet-visible spectrophotometry (UV) and high-performance liquid chromatography (HPLC) for qualitative and quantitative analysis, determination of UV wavelength: 250 nm, HPLC: chromatographic column for Agilent (C18 column 250 * 4.6 mm (including 5 m), methanol, 0.1% citric acid as mobile phase, the wavelength of 250 nm detection, flow rate of 2 ml/min, column temperature 30 °C, sample quantity 10 ul.

The separation and purification of radix puerariae flavonoids by macroporous adsorption resin has the advantages of high elution rate, easy regeneration and so on.

On the review of Zhang et al., (2018) summarized the in vitro and in vivo studies of pharmacological effects of puerarin tuber on geriatric diseases. Puerarin has been used to treat diabetes mellitus and its complications, hyperlipidemia and osteoporosis (Liu et al., 2014; Ropelle, et al., 2013). It supports the claim that puerarin help in the treatment of menstrual pain and excessive bleeding as it improves blood circulation (Zhou et al., 2014). No reviews had been found for other ailments claimed using traditional treatments.

Zhang et al., (2018), reported that other effects of puerarin on aging-related diseases such as neuro-degenerative diseases. It was also found effective for lowering elevated blood pressure and when used as anti-arryrthmic and anti-tumor (Zhang et al., 2018). Puerarin increases the glutathione peroxidase (Zhao et al., 2015) and protects neurons against oxidative stress-induced apoptosis (Zhang et al. , 2011). Peurarin is also found effective to decrease the morbidity of ischemic stroke, a kind of cerebrovascular disease as reported by (Wang et al., 2014).

Modern pharmacology study proved that the main effective components in *Radix puerariae* flavones, have a relaxing effect on vascular smooth muscle, nip central inhibition effect, anti-tumor effect, and prevention of osteoporosis (Lei 2011; Lai, 2018). Moreover, puerarin has anti-arrhythmia property. Clinical studies showed that it slows down the heart rhythm, hormone-like effect, can fight estrogen (Wu, 2017; Chen, 2012). Other studies also showed that puerarin can lower blood lipid, protect myocardium, improves microcirculation, act as an anti-oxidant, lower intraocular pressure and decrease blood glucose.

Findings

The four experimental plants were present both in Central China and Western Visayas, Philippines. There were similarities in the use of *A.paniculata* and *L. japonicus* leaves and differences in the use of *C. obtusifolia* and *P. lobata* parts between Central China and Western Visayas, Philippines. The preparations such as decoction, infusion, paste and poultice of these plant parts differed in both countries. The applications such as poultice, drinks, paste, squeezing and rubbing were practiced in Central China and Philippines. Steaming was only performed in the Philippines. The bio-active compound diterpenoid dehydroangropholide was identified in *A. paniculata* leaves, the terpenoids orange cassia and chrysophanol were identified in *C. obtusifolia* leaves, the alkaloid leonurin hydrochloride was present in *L. japonicus* seeds while in *P. lobata* tubers, theflavonoid puerarin was identified.

Conclusions

The decoction, infusion, poultice, squeezing and paste preparations of these herbal plant parts differ in the Philippines and China. The mode of application like poultice, beverage, paste and rubbing were practiced in both countries while steaming was only practiced in the Philippines.

The bio-active compound diterpenoid dehydroangropholide identified in *A. paniculata* leaves, supports the use of plants to treat stomach ache, and diabetes by drinking the infused leaves in the Philippines. In China, local folks drank the decocted leaves to treat diuresis, rheumatism and for uterine contraction.

The terpenoids orange cassia and chrysophanol were extracted from *C. obtusifolia* seeds. This supports the healing practices in China, where the decocted seeds were drinking to treat hepatitis, edema associated with liver problem and hypertension.

The alkaloid leonurine hydrochloride was extracted from *L. japonicus* leaves. In the Philippines, pounded or squeezed fresh leaves were used to treat fever by rubbing the extracted juice on the head of the patient or rubbing on the abdomen area to treat menstrual disorder.

The flavonoid puerarin was identified in *P. lobata* tubers. The claim that puerarin helps in the treatment of menstrual pain and improves blood circulation was supported by scientific explanations. Most healing practices have scientific bases while other practices have no reviews to support the treatment using these herbals.

Recommendations

For further research, in-depth study of rare and indigenous herbal plant species and identification of these plants found in other regions of the Philippines will be done. Study on other traditional healing practices and utilizing Philippine species for phytochemical analysis will be undertaken. The use of herbals that can heal other ailments which were not mentioned by the local healers. Conduct studies on the chemical reactions of the

medicinal plants. Lastly, verify the potency of the bioactive components of herbal plants in this study and processing of identified herbal plants for pharmaceutical production.

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