ORGANOLEPTIC EVALUATIONS, MICROSCOPICAL CHARACTERS, NUTRITIONAL VALUES, ELEMENTAL AND HEAVY METAL ANALYSIS ON POWDERED FLOWERS OF *MAGNOLIA CHAMPACA* (L.) BAILL. EX PIERRE

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Abstract

Magnolia champaca (L.) Baill. ex Pierre belongs to family Magnoliaceae. The flower samples (tepals) were collected from aged old trees of Mount Popa in flowering period during 2022 – 2023. In this study, the organoleptic evaluations, microscopical examination, nutritional contents, and elemental and heavy metals constituents of flowers were analyzed. The organoleptic evaluation was carried out at Department of Botany, University of Mandalay in 2022. In this evaluation, the fresh tepals were yellow in colour, leathery in texture, aromatic in odour and indistinct in taste. The dried tepals were yellow in brown, brittle in texture, aromatic in odour and indistinct in taste. The colour of powdered tepals was dark brown, the texture was rough, the odour was aromatic and the taste was indistinct. The microscopical examination was carried out at Department of Botany, University of Mandalay in 2022. In this study, pitted vessels, spiral vessels, fibers, sclereids, fragment of parenchyma cells, portion of epidermal layers, tannin cells and oil cells were found in powdered flowers. Nutritional values were determined at Small Scale Industries Department, Ministry of Cooperative and Rural Development, Yangon in 2023. Carbohydrate content was the highest (63.77 %) and fat was found as the lowest nutrient (1.98 %) in the powdered flowers. Elemental analysis was performed by using Energy Dispersive X-Ray fluorescence (EDXRF) technique at Department of Chemistry, University of Mandalay in 2023. In elemental analysis, potassium (K) was the highest (66.2 %) among the elements. The heavy metal analysis was carried out at Myanmar Food Processors and Exporters Association (MFPEA), Yangon in 2023. Lead (Pb) was detected at very trace concentration. Arsenic (As), Cadmium (Cd), Chromium (Cr) and Mercury (Mg) were not found in powdered flowers. This research may be helpful in checking the purity and adulterants of powdered flowers of *Magnolia champaca* (L.) Baill. ex Pierre. These flowers may be safety used as a dietary supplement such as a form of herbal tea since it possesses rich source of nutrients and elements and lack of heavy metals.

Keywords: *Magnolia champaca* (L.) Baill. ex Pierre., organoleptic evaluations, microscopical characters, nutritional values, elemental and heavy metal analysis

Introduction

Magnolia champaca (L.) Baill. ex Pierre known as champaca is a large evergreen tree belonging to the family Magnoliaceae. It consists of 12 genera and 220 species of evergreen, trees and shrubs. It is known for its fragrant flowers and its timber is used in woodworking. The tree is native to the Indo-malaya ecozone consisting of South Asia, Southeast Asia-Indochina and Southern China. It occurs in forests from 300 meters to 1200 meters above sea level. It is wild in the forests of the Eastern sub Himalayan tract and lower hills up to 3000ft and also in Assam, Myanmar, South India and Western Ghats (Chopra *et al*. 1956).

Magnolia champaca (L.) Baill. ex Pierre is widely used in both Ayurveda and Siddha medicine. All parts of this plant provide various benefits. The different color of the flower varies according to locality. The large, scented, yellow flowers grow singly, each from base of a leaf.

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The tree starts flowering after the age of 4 – 5 years (Oyen and Xuan Dung 1999). During the flowering period, the tree is covered with thousands of golden yellow flowers with powerful and diffusive fragrance. The flower extract of *M. champaca* (L.) Baill. ex Pierre has antiulcer, antidiabetic and anti-inflammatory properties and hence used in the ailment of ulcer, skin diseases and wounds. (Nadkarni 1954).

World Health Organization (WHO) is keenly interested in the development and utilization of medicinal plant resources in the traditional system of medicine in the developing countries so as to extend the health care to maximum number of populations in these countries (Goud *et al*., 2005). The medicinal properties of plants have also been investigated in the light of recent scientific developments throughout the world, due to their potent pharmacological activities, low toxicity and economic viability. Flowers have been used since as far back as 50,000 years in funeral rituals. Flowers are mainly used for religious purposes. The other most important use of flowers is their use in medicine and cosmetics. Previous investigations on the plant have revealed that it possesses anti-inflammatory, antimicrobial and leishmanicidal activity (Vimala *et al.*, 1997 and Takahashi *et al.*, 2004).

It has been cultivated as the shady plant and ornamental plant in Myanmar especially at Mount Popa. The large, tall and old plants of *Magnolia champaca* (L.) Baill. ex Pierre are found at Mount Popa. In the flowering time these beautiful, attractive and fragrant fresh flowers are sold in the market and roadside of this region. The preserved flowers of this plant are also sold throughout the year. The flowers of this plant have both aesthetic and medicinal values.

The aim of the present study was to evaluate the purity and safety use of the flowers of *Magnolia champaca* (L.) Baill. ex Pierre. The objectives were to evaluate the organoleptic and microscopical characters, to analyze the elemental and heavy metals constituents and to evaluate the nutritional values of the flowers of *Magnolia champaca* (L.) Baill. ex Pierre.

Materials and methods

Plant samples collection and preparation

The fresh flower samples of *Magnolia champaca* (L.) Baill. ex Pierre. were collected from Mount Popa, Kyaukpadaung Township, Mandalay Region. from July, 2022 to September, 2023. The collected flowers samples were rinsed thoroughly to remove impurities. These samples were air- dried and grinded into the appropriate size and kept in the air- tight containers to use in the studies of organoleptic evaluation, microscopical evaluation, nutritional values, elemental and heavy metal analysis.

Organoleptic evaluation of powdered flowers of *Magnolia champaca* L.

Organoleptic parameters of fresh, dried and powdered flowers samples were evaluated by using organs of senses. In this study, colour, texture, odour and taste of powdered flowers were evaluated.

Microscopical evaluation of powdered flowers of *Magnolia champaca* L.

The microscopic characters of powdered flowers were evaluated to identify the diagnostic characters. The detection of important parameters such as various cellular tissues, types of trichomes and stomata, crystals and oil cells were carried out to provide the identification of crude drugs by Metcalfe and Chalk (1950), Wallis (1967) and Evans (2009).

Elemental analysis of powdered flowers from *Magnolia champaca* (L.) Baill. ex Pierre by using Energy Dispersive X-Ray Fluorescence (EDXRF)

The qualitative elements were analyzed by using Energy Dispersive X-Ray Fluorescence (EDXRF) spectrometer technique at the Department of Chemistry, University of Mandalay in 2023. The EDX 700 spectrometer can detect a wide range of the elements from Aluminum (Al) to Barium (Ba). The required data can be produced in a few minutes and it has high degree of resolution for the spectrum evaluation. Due to it high sensitivity, the spectrometer can detect the relative concentration of elements in the percentage (%) range. The flower samples were dried at room temperature. Then, the dried flowers were ground to get fine powder. The dried powder sample (2g) were pressed into pellets and used in Energy Dispersive X-Ray Fluorescence (EDXRF) spectrometer, which produce the characteristic X- Ray spectrum of sample, consisting of the respective elements.

Heavy metals analysis by using Atomic Absorption Spectrophotometric (AAS) from powdered flowers of *Magnolia champaca* (L.) Baill. ex Pierre

Heavy metal analysis was carried out at the Laboratory of Myanmar Food Processors and Exporters Association (MFPEA), Yangon. AAS has been developed primarily for determining metals at low concentrations levels. AAS is highly sensitive for a wide range of elemental analysis which is difficult or impossible to analysis by flame photometry. It is rapid, specific and need only a small amount to analyze. This method is especially used for trace element and heavy metal analysis.

The Perkins and Elmer Analyst 800 spectrophotometer was used in this experiment. The collected samples were placed in the porcelain basin in a furnace starting at 20°C burning to 500°C and maintained at this temperature for 4 hours, and then sample ash was cooled at room temperature. After cooling, ash was digested with 10 ml of hydrochloric acid to get solution sample. This solution was carefully closed and heated at 200°C for about 10 minutes. The sample solution was cooled and filtered with filter paper. 1 mL of sample solution was added into the 100 ml volume metric flask. And then, 1 mL of this solution was diluted with 99 ml of de-ionized water and placed at the normal room temperature about 24 hours. This solution was analyzed by using atomic absorption spectrometer (AAS 800).

Nutritional values of flowers of *Magnolia champaca* (L.) Baill. ex Pierre

The flowers of *Magnolia champaca* (L.) Baill. ex Pierre were evaluated for its nutritive value at Small Scale Industries Department, Ministry of Cooperative and Rual Development, Yangon in 2024. The nutritional values have been undertaken according to the Association of Official Analytical Chemists (AOAC) method (Horwitz, 1980).

Determination of protein content

The protein was determined according to methods in carbohydrate Chemistry,1978. Each sample was accurately weighed from 0.1 to 1 g into the digestion flask (kjedahl flask). One gram of copper sulphate and 10g of anhydrous sodium sulphate and 10 mL of concentrated sulphuric acid were added one after another. The flask was kept in an inclined position on a heating mantle and heated gently until the foaming ceases. A small amount of paraffin was added to reduce foaming. The solution was boiled vigorously until clear. The digestion flask was then cooled and about 200 mL of distilled water and 75 mL of sodium hydroxide solution were added into it. A

few zinc granules were also added. The digestion flask was connected immediately to the distillation ball or trap on the condenser, and the tip of the condenser must be immersed in a 25 mL of standard acid (0.5 N or appropriate 0.1 N) in the conical flask. Then, the flask was rotated to mix the contents thoroughly and heated immediately, until all ammonia had distilled over (at least 150 mL distillate). The receiver must be lowered down first before distillation was complete and the tip of the condenser must be washed with distilled water. The excess acid was filtrated with standard 0.1 N sodium hydroxide using methyl red as an indicator by the method of A.O.A.C (Horwitz, 1980). Protein content was then calculated by the following formula.

$$\% \text{ protein} = \frac{(x\text{-}y) \times 0.014 \times N \times 6.25 \times 100}{\text{wt. of sample (g)}}$$

Determination of fiber content

About 2g of each sample was accurately weighed and introduced into a 500 mL flask. Then, 200 mL of 1.25% sulphuric acid was added. The contents were refluxed for 30 minutes and then filtered through linen clothe in a fluted funnel. The residue was thoroughly washed with hot distilled water until he washing was no larger acidic. The residue was washed back quantitatively into the flask with 100 mL of distilled water; 100 ml of 2.5 NaOH solution were added and refluxed exactly for 30 minutes. It was then filtered thoroughly with hot distilled water. Next it was washed with 1% HCl and again with hot distilled water till free from acid. The remaining water squeezed out as far as possible. Finally, the residue was washed with a small amount of 95% ethanol. The residue was transferred quantitatively into a weighed crucible and dried to a constant weight in an oven at 105°C for three hours. It was cooled in desiccators and weighed.

The crucible and contents were ignited in a muffle furnace (600°C) until a white ash was obtained. It was cooled and weighed. The difference in two weights represents the weight of crude fiber by the method of A.O.A.C (Horwitz, 1980).

$$\% \text{ of Crude fiber} = \frac{\text{wt. of fiber (g)}}{\text{wt. of sample (g)}}$$

Determination of fat content

The fat content was determined by the Soxhlet extraction method. Sample 50 g were placed in a thimble. The neck of thimble was plugged with a little cotton wool to percent the sample from floating out. TH thimble was introduced into a Soxhlet extractor and the extractor was connected to the flask and condenser. For extraction, exactly 200 mL of petroleum ether was used. When the solvent colorless, the extraction was stopped, it took about 6 hours. The petroleum ether extract was concentrated to small volume and transferred to a weighed beaker. It was evaporated to dryness on water bath. The residue containing beaker was weighed. The difference weight of residue containing beaker was because of the weight of fat by the method of A.O.A.C (Horwitz, 1980).

$$\% \text{ non-volatile residue (fat)} = \frac{\text{wt. of residue} \times 100}{\text{wt. of sample (g)}}$$

Determination of carbohydrate

An accurately weighed 1 g of sample was placed in a round bottom flask (500 cm^3), to which distilled water (200 cm^3) were added. The mixture was then boiled gently under a reflux condenser for 2 – 5 hours, cooled and neutralized solution was the filtered into a volumetric flask (250 cm^3). The round bottomed flask was washed several times with distilled water and the washing added to the volume matrix flask. The solution in the flask was made up to the made up to the mark with distilled water. Aliquots (3 x 10 cm^3) of the Fehling's solution were titrated with the above dilute hydrolyzed solution using methylene blue as an indicator. The amount of glucose calculated from the volumetric analysis multiplied by 0.93 as in equal to the amount of starch by the method of A.O.A.C (Horwitz, 1980).

$$\text{Reducing sugar \% (Dextrose \%)} = \frac{\text{Make volume 100 or 200} \times 0.3 \text{ first titrated volume of value} \times 0.5 \text{ HCL}}{\text{Second titrated volume} \times 20 \text{ ml of } 0.5 \text{ M HCL} \times \text{sample wt. (g)}}$$

Results

Family	-	Magnoliaceae
Scientific name	-	*Magnolia champaca* (L.) Baill. ex Pierre
English name	-	Champaca
Myanmar name	-	Sagawa

Distinct characters of *Magnolia champaca* (L.) Baill. ex Pierre

Perennial tree, leaves simple, alternate, petiolate, inflorescences axillary cyme, flower bisexual, hypogynous, stamens numerous, carpels many, apocarpous, parietal placentation, fruits follicle, stipule scar.

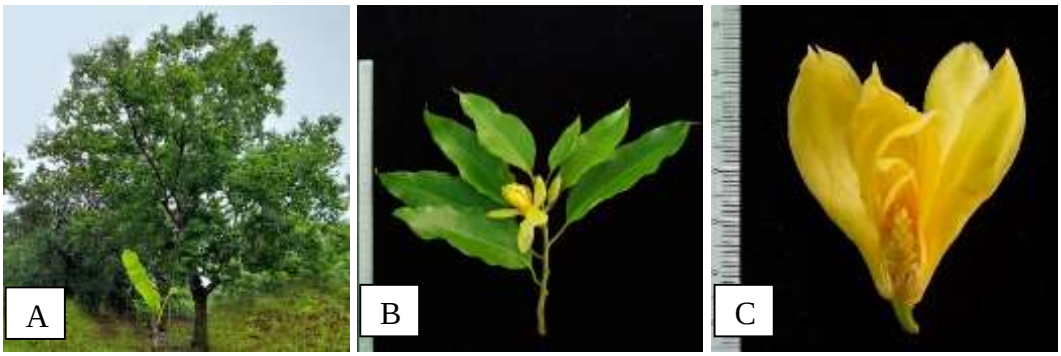

Figure 1 Morphological characters of *Magnolia champaca* (L.) Baill. ex Pierre. A. Habit, B. Inflorescence, C. L.S of flower

Organoleptic evaluation and Microscopic evaluation of powdered flowers of *Magnolia champaca* L.

Table 1 Organoleptic evaluation of tepals of *Magnolia champaca* (L.) Baill. ex Pierre.

No.	Organoleptic evaluation	Fresh tepals	Dried tepals	Powdered tepals
1	Colour	Yellow	Orange brown	Dark brown
2	Texture	Leathery	Brittle	Rough
3	Odour	Aromatic	Aromatic	Aromatic
4	Taste	Indistinct	Indistinct	Indistinct

Figure 2 Flowers (tepals) samples of *Magnolia champaca* (L.) Baill. ex Pierre. A. Fresh tepals, B. Dried tepals, C. Powdered tepals

Microscopical evaluation of powdered flowers of *Magnolia champaca* L.

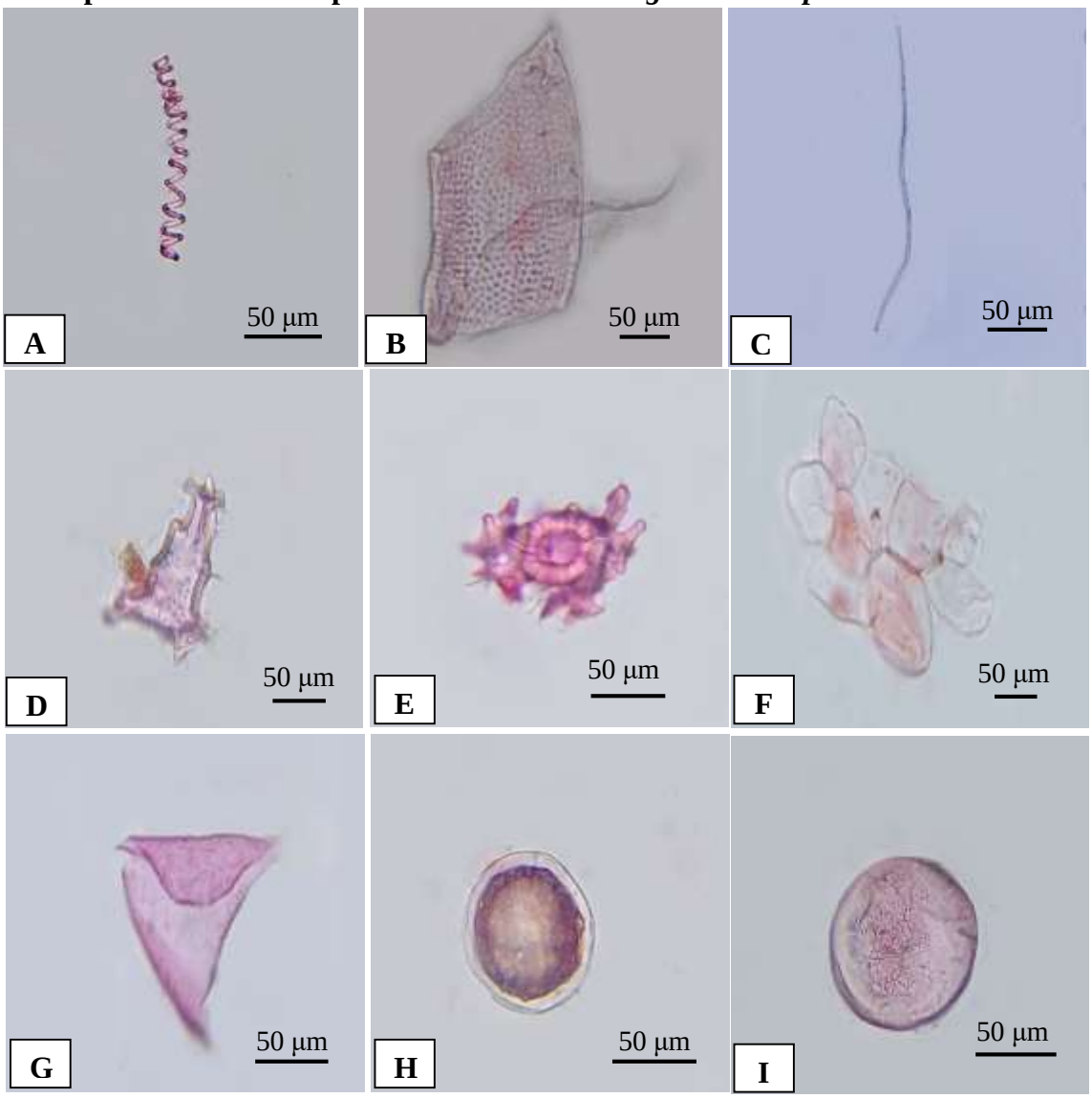

Figure 3 Microscopical characters of powdered tepals of *Magnolia champaca* (L.) Baill. ex Pierre. A. Spiral vessels, B. Pitted vessel, C. Fiber, D and E. Scelerids, F. Fragment of parenchyma cells, G. Fragment of epidermal layer, H. Tannin cell, I. Oil cell

Nutritional values of powdered flowers of *Magnolia champaca* (L.) Baill. ex

Table 2. Nutritional values of powdered flowers of *Magnolia champaca* (L.) Baill. ex Pierre

No	Constituents	Content (%)
1	Protein	11.78
2	Fiber	17.62
3	Fat	1.98
4	Carbohydrate	63.77
5	Energy Value (Kcal/100g)	320.02

Energy Dispersive X- Ray Fluorescence Spectrometric analysis (EDXRF) of *Magnolia champaca* (L.) Baill. ex Pierre flowers

Table 3 Energy Dispersive X- Ray Fluorescence Spectrometric analysis (EDXRF) of *Magnolia champaca* (L.) Baill. ex Pierre flowers

No	Component	Analyzed value
1	Potassium (K)	66.2
2	Calcium (Ca)	13.5
3	Magnesium (Mg)	7.13
4	Phosphorous (P)	4.14
5	Sulphur (S)	2.43
6	Aluminium (Al)	2.27
7	Silicon (Si)	1.64
8	Iron (Fe)	0.850
9	Chlorine (Cl)	0.515
10	Copper (Cu)	0.224
11	Zinc (Zn)	0.194
12	Nickel (Ni)	0.185
13	Tin (Sn)	0.157
14	Manganese (Mn)	0.153
15	Rubidium (Rb)	0.145
16	Strontium (Sr)	0.142
17	Titanium (Ti)	0.0580
18	Hafnium (Hf)	(0.0258)
19	Vanadium (V)	(0.0087)
20	Chromium (Cr)	(0.0085)
21	Molybdenum (Mo)	(0.0081)
22	Silver (Ag)	0.0040
23	Bromine (Br)	(0.0030)
24	Ruthenium (Ru)	(0.0017)
25	Carbon monoxide (Co)	ND

No	Component	Analyzed value
26	Gallium (Ga)	ND
27	Germanium (Ge)	ND
28	Arsenic (As)	ND

Atomic Absorption Spectrophotometric (AAS) analysis of *Magnolia champaca* (L.) Baill

Table 4 **Heavy metals analysis of flowers of *Magnolia champaca* (L.) Baill. ex Pierre**

No.	Test Parameter	Result	Unit	Limit of Detection
1	Arsenic (As)	ND	mg/kg	0.74 ppm
2	Cadmium (Cd)	ND	mg/kg	0.03 ppm
3	Chromium (Cr)	ND	mg/kg	0.09 ppm
4	Lead (Pb)	0.22	mg/kg	0.09 ppm
5	Mercury (Mg)	ND	µg/kg	0.09 ppb

Discussion

In this study, the organoleptic and microscopical characters, presence of elements, heavy metals and nutritional constituents in the flowers of *Magnolia champaca* (L.) Baill. ex Pierre were analyzed. In organoleptic evaluation, the colour, texture, odour and taste of fresh, dried and powdered tepals were examined. The colour of fresh tepals was yellow and turns brown when dried and dark brown in powder state. The texture was leathery in fresh tepals, brittle in dried tepals and rough in powdered tepals. The odour and taste of all three samples was aromatic and indistinct. These evaluations were agreed with Desale *et al*. (2022) who reported that the flowers of this plant are pale yellow to deep yellow and very fragrant. The findings from this study were also in agreement with Geetha *et al*. (2011) and Desai and Lalitha (2018) who mentioned that these powdered flowers were orange brown or dark brown, characteristic odour and gritty texture with uneven coarse particles.

In microscopical study, spiral and pitted vessels, fiber, sclereids (stone cells), fragment of parenchyma cells, fragment of epidermal layer, oil cells and tannin cells were examined in the powdered flowers. These observations were the same with Desai and Lalitha (2018) who stated that the microscopical characters of powdered flowers shows the presence of parenchymatous cells, vessels with spiral thickening, lignified stone cells and oil globules. The analysis of nutritional value of the flowers of *Magnolia champaca* (L.) Baill. ex Pierre flowers showed the presence of protein (11.78%), fiber (17.62%), fat (1.98%), carbohydrate (63.77%) and energy value (320.02%). Among them carbohydrate was found to the highest content. The findings are in agreement with Jakubczyk *et al.* (2022).

According to Energy Dispersive X-ray Fluorescence Spectroscopy (EDXRF), Potassium, Calcium, Magnesium, Phosphorous, Sulphur, Aluminium, Silicon were analyzed in the flowers of *Magnolia champaca* (L.) Baill. ex Pierre. The Potassium was the highest among the elements. Atomic Absorption Spectrophotometry (AAS) analysis showed the trace amount of lead (0.22

ppm) was present in this flower. The WHO limit for lead in herbal drugs was 10 ppm (Olanrewaju *et al*., 2017). Arsenic (As), Cadmium (Cd), Chromium (Cr) and Mercury (Mg) were not detected in this flower. Therefore, these flowers can be used safely as a medicinal plant.

Conclusion

Magnolia champaca (L.) Baill. ex Pierre flowers have been used as a source of essential oil and in traditional medicine. Because of these uses and demand, the flowers may be adulterated. This study may be helpful to detect the adulterants and to distinguish between the closely related species of these flowers especially in the powder forms. These flowers may be safety used as a dietary supplement such as a form of herbal tea since it possesses rich source of nutrients and elements and lack of toxic heavy metals. These flowers are useful in many purposes such as in aesthetic, culture and medicine. Many kinds of medicinal plants including the old-aged trees of *Magnolia champaca* (L.) Baill. ex Pierre are grown in Mount Popa, an oasis in the desert-like dry central zone of Myanmar. The aromatic and attractive *Magnolia champaca* (L.) Baill. ex Pierre flowers are also the trademark of this area. Therefore, the conserving of these ancient, large and medicinal trees is important to protect the natural forest ecosystem in Mount Popa. For this regard long existing of *Magnolia champaca* (L.) Baill. ex Pierre trees play important role in contributing floral diversity of Mount Popa, which will be designated as "Geopark" in near future.

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