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EVALUATION OF NUTRIENT AND MINERAL CONTENT OF THE LEAVES OF *PHLOGACANTHUS PULCHERRIMUS* CULTIVATED IN THAILAND

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Abstract: *Phlogacanthus pulcherrimus* (T. Anderson), a medicinal plant in Acanthaceae family, has been traditionally used in Thai herbal medicine as diuretics and a nutritional supplement or tonic. The objective of this study was to determine the proximate composition and constituent minerals of *P. pulcherrimus* leaves from 6 different agro-climatic regions distributed in Thailand. By the nutrition value assessment, the content of protein, fat, fiber, and moisture. were found in the range of 3.68-4.17%;0.83-1.22%; 3.47-5.35%, and; 81.20-84.59% of moisture respectively; meanwhile the average content of mineral, which are calcium, sodium, potassium, magnesium, chromium and iron were 105.60, 2.24, 71.24, 86.28, 0.13, and 1.23 mg/100 g, respectively**.** The results revealed that *P. pulcherrimus* leaves indigenous to different agro-climatic regions of Thailand contained an appreciable amount of nutrients and might be used as a good supplement for minerals.

Keywords: *Phlogacanthus pulcherrimus***,** proximate analysis, mineral content

บทคัดย่อ: *Phlogacanthus pulcherrimus* (T. Anderson) ซึ่งเป็นพืชสมุนไพรอยู่ในวงศ์ Acanthaceae ใช้เป็นยาขับปัสสาวะและบำรุงร่างกายของยาสมุนไพรไทย วัตถุประสงค์ของการศึกษานี้เพื่อทำการวิเคราะห์หาปริมาณสารประกอบหลักและแร่ธาตุในใบ *P. pulcherrimus* จากแหล่งเพาะปลูก 6 แหล่ง ในประเทศไทย พบว่า ใบ *P. pulcherrimus* มีโปรตีน ไขมัน เส้นใย และ ความชื้นในช่วง 3.68-4.17%; 0.83-1.22%; 3.47-5.35%; และ 81.20-84.59% ปริมาณแร่ธาตุ แคลเซียม โซเดียม โปแตสเซียม แมกนีเซียม โครเมียม และเหล็ก 105.60, 2.24, 71.24, 86.28, 0.13, และ1.23 มิลลิกรัม ต่อ 100 กรัมน้ำหนักแห้ง ตามลำดับ ผลการวิเคราะห์คุณค่าสารอาหารในใบ *P. pulcherrimus* พบว่ามีคุณค่าสารอาหารที่ดีอาจใช้เป็นผลิตภัณฑ์เสริมอาหาร เช่น เกลือแร่ โดยแต่ละแหล่งมีปริมาณต่างกัน ขึ้นอยู่กับสภาพภูมิอากาศสภาพดินที่ใช้ในการเพาะปลูก

คำสำคัญ *Phlogacanthus pulcherrimus*, การวิเคราะห์หาปริมาณสารประกอบหลัก, ปริมาณแร่ธาตุ

INTRODUCTION

Plants are very efficient at synthesising primary metabolites via photosynthesis from inorganic compounds, found in environment (Dewick, 2009). They can produce two types of metabolites: primary metabolites involving nutritive value (protein, carbohydrate and lipid) and secondary metabolites which are the major source of medicine for human body (Manikanda and Doss, 2010). Animals and humans require number of minerals and trace

elements for numerous biological and physiological processes which are essential for health maintenance (Abbas *et al.*, 2011).

Phlogacanthus pulcherrimus is categorised in the major group of angiosperms in Acanthaceae family. It has been traditionally used in Thai herbal medicine as diuretics and nutritional supplements or tonic. It has common names depending on area found in Thailand such as "Dee Pla Kang, Dee Krating" (Somprasong *et al.*, 2011). *P. pulcherrimus* is a gregarious shrub, growing up to 50 cm. or more height (Hansen, 1985). The fruits are loculicidal capsule and seed dispersal (Beatrice *et al.*, 2005). This plant has long violet-red tubular flowers, appearing in terminal elongated (Cramer, 1998). Fresh leaves of the plant are eaten as tonic food by stirring with minced meat in the North Region of Thailand. Although the leaves have been used as food for human, there are no published reports for nutrition value of *P. pulcherrimus* leaves which cultivated in Thailand. Thus, the purpose of this study was to assess nutritional value including protein, fibre, potassium, calcium, iron, sodium, magnesium and chromium content of *P. pulcherrimus*, planted in Thailand.

MATERIALS AND METHODS

P. pulcherrimus leaves were collected from natural surroundings in June – October 2013 from 6 different provinces in Thailand which were Chiang Mai, Nan, Phayo, Phetchabun, Phrae and Bangkok. *P. pulcherrimus* leaves were authenticated by Dr. Thanapat Songsak. Fresh leaves were weighed and freeze-dried. The freeze-dried leaves were weighed, grounded and kept in air-tight plastic containers at room temperature (30°C) for further analysis. Leaves from each region were assayed and analysed individually in triplicate. Proximate analysis procedure including the percentage of moisture content, crude protein, crude fat, ash content and crude fibre in the sample (Table 1) were determined by the Association of Official Analytical Chemists methods (AOAC). Likewise, potassium, calcium, iron, sodium, magnesium and chromium were determined by the use of atomic absorption spectrophotometer (AAS), Varian SpectrAA 220 (Table 2).

Proximate analysis:

Moisture content: An aluminium dish was placed in an oven at 105°C for 2 h and allowed to cool in a desiccator. The aluminium dish was weighed and 2 g of the finely ground leaves was accurately weighed and placed on the aluminium dish. The samples were dried by using drying oven (Memmert 600, Germany) at 105°C and sporadically weigh until the weight of sample is constancy. Subsequently weighed and calculated the percentage of dry weight and the percentage of moisture content after cooling it down in the desiccators.

Ash: A crucible was heated at 105°C for 2 h in a hot air oven and allowed to cool in a desiccator. The crucible was accurate weighed and about 2 g of the powder was placed in a crucible and accurately weighed. The crucible with sample was incinerated at low flame and then burnt at 550°C in a muffle oven (Furnace Nabertherm, Germany) for 8 h. After that it was allowed to cool in a desiccator and accurately weighed. The weight difference of crucible without the leaves sample before and after ashing was used to determine the percentage of ash.

Fat: Fat content was determined by Soxhlet extractor (Gerhadt, Germany). About 2-g of finely ground sample was accurately weighed and extracted with petroleum ether for 4 h. The extract was collected in a round bottom flask.

Crude protein: Crude protein content of the samples was determined by macro-Kjeldahl method, in which the ground sample was digested with 98% sulphuric acid. The digested material was distilled after the addition of alkali. The ammonia released was collected in a 4% boric acid solution. The resultant boric acid solution which contained the ammonia released was titrated with 0.1 N HCl volumetric solution.

Crude fibre: Two grams of sample was weighed and put into a 250-mL conical flask and 1.25% sulfuric acid solution was added. The sample was boiled for 30 min, filtered then washed until traces of acid could not be detected using pH paper. The Whatman paper 5B with 125 micrometer pore size was placed in the Buchner flask. The acid extracted was transferred into a 250-mL conical flask and 1.25% NaOH solution was added subsequently. The sample was boiled again for 30 min, filtered using vacuum filter and washed with water until base was undetected. The sample was transferred into a crucible and dried for 12 h at 120°C. After that the crucible was placed into muffle oven at 550°C for 12 h and weight of crucible was recorded.

Mineral Analysis:
All mineral assays were performed after wet ashing the samples. About 2.5 g of leaves was accurate weighed and ashed at 550°C overnight. The ash was dissolved in 25 ml concentrated nitric acid and heated for 40 min. After it was allowed to cool, perchloric acid (10 ml) was carefully added. It was heated again until the fume appeared. Fifty mL of deionised water was added into the cooled sample. The resulting solution was transferred to a 250-ml volumetric flask and adjusted to a volume. The absorbance of the solution was determined using the AAS.

Determination of minerals:
Working standard solutions of calcium (Ca), sodium, (Na), potassium (K), chromium (Cr) and iron (Fe) were prepared from stock standard solution (1000 ppm), in 2 N HNO_3 and absorbance was noted for standard solution of each element and samples using AAS (Nile and Khobragade,2009).

Statistical analysis:
One way analysis of variance and Turkey's test was performed to determined differences in nutrient and mineral content of *P. pulcherrimus* leaves of six different samples. The significance level less than 0.05 was accepted for all comparisons SPSS statistics, version 16.0 for Windows was used for the statistical analysis.

RESULTS AND DISCUSSION

The average content of carbohydrate, fat, protein, and crude fibre in *P. pulcherrimus* leaves were 2.39, 1.04, 3.97 and 4.55%, respectively (Table 1); meanwhile the average content of mineral which are calcium, sodium, potassium, magnesium, chromium and iron were 105.60, 2.24, 71.24, 86.28, 0.13 and 1.23 mg/100 gram, respectively (Table 2).

Table 1. Proximate analysis of *P. pulcherrimus* leaves from six different provinces

Sample	Content (mg/100 g)					
	Moisture	Ash	Crude fat	Crude Protein	Crude fibre	Carbohydrate
Chiang Mai	82.463±0.75^{b}	3.73±0.03^{d}	1.22±0.10^{a}	4.06±0.20^{a}	4.57±0.54^{b}	3.96±0.20^{a}
Nan	83.61±0.63^{ab}	4.45±0.05^{c}	1.06±0.08^{ab}	4.17±0.104^{a}	5.15±0.10^{a}	1.55±0.86^{bc}
Phayo	81.20±0.50^{c}	5.66±0.10^{a}	0.89±0.11^{b}	3.68±0.21^{b}	3.47±0.08^{c}	5.10±0.65^{a}
Phetchabun	84.34±0.36^{a}	4.93±0.15^{b}	0.83±0.17^{b}	4.00±0.17^{ab}	3.74±0.17^{c}	2.17±0.69^{b}
Phrae	84.59±0.52^{a}	4.50±0.08^{c}	1.20±0.05^{a}	3.85±0.16^{ab}	5.35±0.25^{a}	0.51±0.42^{c}
Bangkok	83.35±0.35^{ab}	5.52±0.03^{a}	1.07±0.09^{ab}	4.04±0.22^{a}	4.99±0.21^{ab}	1.04±0.83^{bc}
mean±SD	83.26±1.27	4.80±0.69	1.04±0.17	3.97±0.22	4.55±0.77	2.39±1.79

Values were presented in mean±SD (n=3) followed by different letters imply the significant different ($p<0.05$) between values in the same column.

Table 2. Mineral Composition of *P. pulcherrimus* leaves from six different provinces

Sample	Content (mg/100g)					
	Potassium	Calcium	Iron	Sodium	Magnesium	Chromium
Chiang Mai	75.95±1.73^{c}	145.27±5.32^{b}	1.85±0.41^{a}	1.55±0.23^{d}	119.30±2.46^{a}	0.10±0.01^{b}
Nan	80.21±0.63^{b}	155.41±3.32^{a}	1.64±0.37^{ab}	2.56±0.24^{b}	96.76±1.06^{c}	0.10±0.26^{b}
Phayo	83.9±2.05^{b}	67.95±4.85^{e}	1.32±0.15^{b}	1.84±0.05^{cd}	105.18±0.75^{b}	0.18±0.03^{a}
Phetchabun	39.65±3.33^{d}	59.98±4.01^{f}	0.57±0.08^{c}	2.18±0.08^{c}	55.39±0.61^{e}	0.10±0.00^{b}
Phrae	105.05±0.95^{a}	121.58±1.60^{c}	1.12±0.04^{b}	1.64±0.05^{cd}	91.85±0.99^{d}	0.10±0.03^{b}
Bangkok	42.68±2.66^{d}	83.40±3.45^{d}	0.88±0.11^{bc}	3.68±0.06^{a}	47.81±0.14^{f}	0.20±0.03^{a}
mean±SD	71.24±23.90	105.60±38.40	1.23±0.49	2.24±0.76	86.28±26.97	0.13±0.05

Values were presented in mean±SD (n=3) followed by different letters imply the significant different ($p<0.05$) between values in the same column.

CONCLUSION

This study demonstrated that leaves of *P. pulcherrimus* cultivated in Thailand contain high concentration of calcium, potassium and magnesium and are suitable for fortification of foods. These plant organs might be explored as a viable supplement and a ready source of dietary minerals in human food.

The results of present analysis revealed that *P. pulcherrimus* leaves indigenous to different agro-climatic regions of Thailand contained an appreciable amount of nutrients and might be used as a good supplement for some nutrients such as fibre and minerals.

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