Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(5), 1972-1977 | ISSN:2251-6727

Evaluation of Antioxidant Activity and Phenolic Compound Levels in Indigenous Vegetables of Thailand

Pimprapa Intahlor

Faculty of Sport and Health Sciences, Thailand National Sport University, Chiang Mai Campus, Chiang Mai 50000, Thailand.

(Received: 16 July 2025 Revised: 20 August 2025 Accepted: 29 September 2025)

KEYWORDS
Antioxidant activity;

Phenolic Compounds;

Indigenous Vegetables

ABSTRACT:

Introduction: Thailand is currently facing major public health challenges from non-communicable diseases (NCDs), largely driven by inappropriate dietary habits and lifestyle factors. These diseases progress gradually, leading to severe complications and high mortality rates. The consumption of local vegetables plays an essential role in reducing such risks, as they are rich sources of antioxidants that inhibit oxidative processes associated with chronic diseases. Complementary and Alternative Medicine (CAM) has emphasized the therapeutic potential of herbs and indigenous plants, recognizing their safety and efficacy. International research, such as studies on *Moringa stenopetala* extracts in Algeria, has revealed high levels of phenolics and flavonoids with strong antioxidant and anti-inflammatory activities. Similarly, several Thai studies report that local vegetables exhibit antioxidant activity exceeding 80% and contain bioactive compounds, particularly phenolics and flavonoids, which are associated with the prevention of diabetes, cancer, and cardiovascular diseases. Thai indigenous vegetables are valuable, easily accessible, and regionally diverse. Therefore, analyzing their antioxidant activity and phenolic content is crucial—not only to build fundamental knowledge and encourage sustainable consumption, but also to provide a foundation for developing raw materials for functional foods and herbal products that support preventive healthcare.

Objectives: To analyze the antioxidant activity and phenolic compound content of local vegetables in Thailand.

Methods: This experimental research analyzed 28 species of Thai indigenous vegetables. The study was divided into two parts: (1) Antioxidant activity was evaluated using the DPPH radical scavenging assay. DPPH solutions and Trolox standards at various concentrations were reacted with vegetable extracts, and absorbance was measured at 517 nm using a UV–Visible Spectrophotometer. The results were used to calculate the percentage inhibition (% inhibition) and the half-maximal inhibitory concentration (IC_{50}). (2) Total phenolic content was determined by the Folin–Ciocalteu colorimetric method, with gallic acid as the reference standard. Absorbance was measured at 765 nm, and results were expressed as milligrams of gallic acid equivalent per gram of sample (mg GAE/g).

Results: Antioxidant activity varied across vegetables from different regions. In the Northern region, *Ocimum gratissimum* exhibited the highest activity; in the Northeastern region, *Spondias pinnata* showed the greatest activity; in the Central region, *Ocimum sanctum* was the most potent; and in the Southern region, *Curcuma longa* demonstrated the highest antioxidant activity. Overall, *Ocimum sanctum* from the Central region exhibited the strongest activity (TEAC 198.95 mg/ml), followed by *Curcuma longa* from the Southern region (153.06 mg/ml). Regarding phenolic content, *Ocimum gratissimum* had the highest levels in the Northern region, *Spondias pinnata* in the Northeastern region, *Ocimum sanctum* in the Central region, and *Parkia speciosa* in the Southern region. Nationally, *Parkia speciosa* from the Southern region contained the highest phenolic content (213.34 mg/ml), followed by *Ocimum sanctum* from the Central region (122.47 mg/ml).

Conclusions: This study demonstrates that Thai indigenous vegetables are promising sources of antioxidants and phenolic compounds, particularly *Ocimum sanctum*, *Curcuma longa*, *Ocimum*

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(5), 1972-1977 | ISSN:2251-6727

gratissimum, *Spondias pinnata*, and *Parkia speciosa* Hassk. Their antioxidant capacity may be influenced by the quantity and type of bioactive compounds present, as well as environmental conditions affecting secondary metabolite synthesis. These findings provide a scientific basis for promoting the consumption of local vegetables for preventive nutrition and support the potential development of functional foods, herbal supplements, and precursors for novel therapeutic agents in the future.

1. Introduction

In recent years, Thailand has placed increasing emphasis on a healthy lifestyle aimed at disease prevention and well-being. However, dietary patterns among the Thai population remain a major risk factor for non-communicable diseases (NCDs), a group of illnesses not caused by pathogens but by lifestyle and behavioral factors. These diseases progress gradually, with cumulative effects that eventually lead to chronic conditions. Without timely and appropriate treatment, they significantly impair patients' quality of life and often result in mortality (1). By contrast, populations that consume vegetables and fruits regularly demonstrate reduced risks, as these foods are rich in antioxidants that neutralize free radicals. Free radicals are responsible for oxidative stress and cellular damage, both of which are linked to the onset of chronic diseases. This growing recognition has led to increasing interest in the consumption of indigenous vegetables and medicinal plants as preventive dietary strategies.

Complementary and Alternative Medicine (CAM) has highlighted the therapeutic potential of herbal and plant-derived compounds due to their safety and efficacy. In hospital settings, CAM has been applied in addressing medical issues such as infections, complications, and preventive health care (2). Numerous studies worldwide have investigated the antioxidant and phenolic contents of local vegetables. For example, an evaluation of *Moringa stenopetala* from the Sahara Desert in Algeria demonstrated high levels of total phenolics (101.081 mg GAE/g dry weight) and flavonoids (73.826 mg QE/g dry weight) in leaves. Methanol extracts from roots and leaves showed the strongest antioxidant activity with IC_{50} values of 0.159 ± 0.014 and 0.169 ± 0.004 mg/mL, respectively, along with significant anti-inflammatory effects (3). Similarly, in China, *Ocimum basilicum* (sweet basil) has been traditionally applied to control postpartum bleeding, relieve menstrual pain, manage arthritis, treat asthma, and stimulate appetite. Basil leaves have also been reported to exhibit antimicrobial, anti-inflammatory, immunomodulatory, and antioxidant activities, as well as protective effects against cardiovascular disease (4).

In Thailand, indigenous vegetables play an essential role in both nutrition and folk medicine, reflecting the country's cultural heritage. Their diversity varies across regions due to differences in climate and dietary practices (5). These vegetables are rich in bioactive compounds, particularly phenolics, flavonoids, and antioxidants, which contribute to reducing the risk of NCDs such as diabetes, cancer, and cardiovascular disease (6,7). Indigenous vegetables in Thailand are commonly categorized into four regions: the North, Northeast, Central, and South (Figure 1). In the North, local vegetables such as *Gymnema inodorum* (Chiangda), known for its hypoglycemic properties, and *Diplazium esculentum* (Pak Kud), rich in antioxidants, are widely consumed (1). *Persicaria odorata* (Pak Phaiw) is traditionally used to relieve diarrhea and inflammation and may also play a role in treating zoonotic diseases such as mastitis (8). In the Northeast, drought-tolerant vegetables such as *Tiliacora triandra* (Yanang), with its tonic and anti-inflammatory effects, and *Cratoxylum formosum* (Pak Tiew), rich in phenolic compounds, are highly valued (9). The Central region is characterized by herbs integral to Thai cuisine, including *Ocimum basilicum* (sweet basil) and *Ocimum tenuiflorum* (holy basil), which possess antimicrobial, anti-inflammatory, and cardioprotective properties (4,10). In the South, local vegetables such as *Gnetum gnemon var. tenerum* (Pak Miang) and *Parkia speciosa* (Sataw) are frequently used in traditional dishes and are abundant in protein, dietary fiber, and antioxidants (11). Thus, Thai indigenous vegetables not only serve as dietary and medicinal resources but also represent valuable cultural assets.

Previous studies have highlighted the strong antioxidant potential of many indigenous vegetables such as *Diplazium esculentum*, *Cratoxylum formosum*, *Basella alba*, *Tiliacora triandra*, and *Melientha suavis*, with radical scavenging activities exceeding 80%. These vegetables are also rich in bioactive compounds that

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(5), 1972-1977 | ISSN:2251-6727

enhance immunity and reduce cancer risk. Among these, phenolic compounds represent the principal group of antioxidants found in Thai indigenous vegetables. Beyond their role in preventing oxidation in food, they exhibit significant biological activities, including antioxidant, anti-inflammatory, and antibacterial effects (6). Their antioxidant properties are strongly associated with a reduced incidence of chronic diseases such as diabetes, cancer, cardiovascular disorders, and neurodegenerative diseases (7,12). For instance, studies analyzing *Piper sarmentosum*, *Persicaria odorata*, *Ocimum americanum* (hoary basil), *Ocimum basilicum* (sweet basil), and *Ocimum tenuiflorum* (holy basil) demonstrated substantial levels of phenolics, flavonoids, and antioxidant capacity when assessed using the Folin–Ciocalteu method, the aluminum chloride colorimetric method, and the DPPH radical scavenging assay, respectively, with gallic acid, quercetin, and Trolox as standards. Notably, *Ocimum americanum* (hoary basil) showed the highest phenolic (139.74 mg GAE/gDW) and flavonoid contents (411.40 mg QE/gDW), as well as antioxidant activity (37.27% inhibition) (1).

Therefore, the analysis of antioxidant activity and phenolic content of Thai indigenous vegetables is vital for building foundational knowledge, supporting preventive health strategies, enhancing the economic value of local plant resources, and developing raw materials for functional foods and herbal medicines. Furthermore, disseminating academic knowledge about the nutritional and medicinal values of these vegetables can encourage sustainable consumption practices aligned with Thai cultural traditions.

Figure 1. Regional map of Thailand.

2. Objectives

The objective of this study was to analyze the antioxidant activity and phenolic compound content of indigenous vegetables in Thailand. A total of 28 species were selected, representing four geographical regions (seven species per region). The research was divided into two main parts: (i) assessment of antioxidant activity using the DPPH radical scavenging assay and (ii) determination of phenolic content using the Folin–Ciocalteu colorimetric method.

3. Methods

This study was designed as an experimental investigation focusing on 28 species of indigenous Thai vegetables, categorized into four groups according to geographical regions:

A. Northern region	**B. Northern region**
A1 *Bauhinia Purpurea Linn*	B1 *Limnophila aromatica*
A2 *Eleutherococcus trifoliatus*	B2 *Anethum graveolens*
A3 *Basella alba*	B3 *Glinus oppositifolius*
A4 *Raphanus caudatus*	B4 *Centella asiatica*
A5 *Gymnema inodorum*	B5 *Spondias pinnata*
A6 *Ocimum gratissimum*	B6 *Piper sarmentosum Roxb*
A7 *Sauropus androgynus*	B7 *Cleome gynandra*
C. Central region	**D.Southern region**
C1 *Spinacia oleracea*	D1 *Curcuma longa*
C2 *Persicaria odorata*	D2 *Parkia speciosa* Hassk
C3 *Ocimum sanctum*	D3 *Gnetum gnemon*
C4 *Momordica charantia*	D4 *Azadirachta indica*
C5 *Garcinia cowa* Roxb. ex Choisy	D5 *Curcuma mangga Valeton & Zijp*
C6 *Mentha spicata*	D6 Glochidion wallichianum Muell. Arg.
C7 *Allium tuberosum* Rottler	D7 *Leucaena leucocephala* (Lam.) de Wit

Figure 2. Indigenous Vegetables in Thailand

Sample Preparation

Each vegetable sample was washed thoroughly, air-dried, chopped into small pieces, and weighed at 20 g. The samples were extracted with 150 mL of 95% methanol at room temperature for 24 hours. The extracts were filtered, and solvents were removed by rotary evaporation at 47–48 °C. The dried residues were then re-dissolved in methanol and adjusted to a final volume of 25 mL for subsequent analyses.

Antioxidant Activity Analysis

The antioxidant activity was assessed using the DPPH radical scavenging assay. DPPH solutions and Trolox standards at different concentrations were prepared and reacted with vegetable extracts. Absorbance was measured at 517 nm using a UV–Visible spectrophotometer. The percentage inhibition (% inhibition) and half-maximal inhibitory concentration

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(5), 1972-1977 | ISSN:2251-6727

(IC_{50}) were calculated according to the following formula:

$$\% \text{ inhibition} = \frac{A_c - A_t}{A_c} \times 100$$

where A_c = absorbance of the control and A_t = absorbance of the test sample.

Phenolic Content Analysis

Total phenolic content was determined using the Folin–Ciocalteu colorimetric method with gallic acid as the standard at various concentrations. Vegetable extracts were reacted with the reagent, and absorbance was measured at 765 nm. Results were compared with a standard calibration curve and expressed as milligrams of gallic acid equivalents per gram of sample (mg GAE/g).

Data Analysis

Quantitative results were derived from absorbance values and linear regression equations. The findings reflect the potential of Thai indigenous vegetables as sources of antioxidants and phenolic compounds. These data provide a scientific basis for preventive nutrition and serve as a foundation for developing functional food products in the future.

4. Results

This study analyzed the antioxidant activity and total phenolic content of 28 indigenous Thai vegetables collected from four geographical regions: Northern, Northeastern, Central, and Southern Thailand. The samples were extracted with 95% methanol, and the extracts were subsequently evaluated using the DPPH radical scavenging assay and the Folin–Ciocalteu method.

Antioxidant Activity of Indigenous Vegetables

The antioxidant activity, expressed as Trolox Equivalent Antioxidant Capacity (TEAC), varied across different vegetables and regions. In the **Northern region**, *Ocimum gratissimum* (A6) exhibited the highest antioxidant activity with a TEAC value of 114.37 mg/mL, followed by *Sauropus androgynus* (A7) and *Gymnema inodorum* (A5). In the **Northeastern region**, *Spondias pinnata* (B5) demonstrated the highest activity (TEAC 137.46 mg/mL), followed by *Piper sarmentosum Roxb* (B6) and *Cleome gynandra* (B7). For the **Central region**, *Ocimum sanctum* (C3) showed the strongest antioxidant capacity with a TEAC of 198.95 mg/mL, followed by *Persicaria odorata* (C2) and *Mentha spicata* (C6). In the **Southern region**, *Curcuma longa* (D1) demonstrated the highest activity (TEAC 153.06 mg/mL), followed by Glochidion wallichianum Muell. Arg. (D6) and *Momordica charantia* (D4).When considering the overall comparison across all regions, *Ocimum sanctum* (C3) from the Central region exhibited the highest antioxidant activity (TEAC 198.95 mg/mL), followed by *Curcuma longa* (D1) from the South (153.06 mg/mL) and *Persicaria odorata* (C2) from the Central region (140.76 mg/mL) (Figure 4).

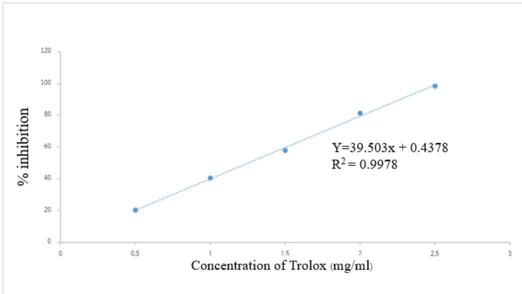

Figure 3. Standard Trolox solution analyzed by the DPPH radical scavenging assay. The antioxidant activity at different concentrations showed a correlation coefficient (R^2 = 0.9978), indicating an acceptable linearity.

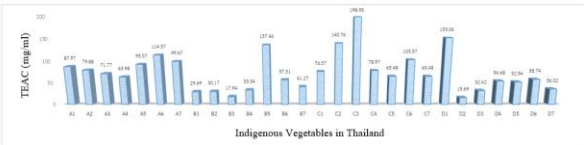

Figure 4. Overall antioxidant activity of extracts from Thai indigenous vegetables.

Phenolic Compound Content of Indigenous Vegetables

The total phenolic content of indigenous vegetables, determined using gallic acid as the standard, varied across regions. In the **Northern region**, *Ocimum gratissimum* (A6) exhibited the highest phenolic content at 102.22 mg/mL, followed by *Raphanus caudatus* (A4) and *Basella alba* (A3). In the **Northeastern region**, *Spondias pinnata* (B5) showed the highest phenolic concentration at 110.30 mg/mL, followed by *Piper sarmentosum Roxb* (B6) and *Limnophila aromatica* (B1). In the **Central region**, *Ocimum sanctum* (C3) recorded the highest phenolic content at 122.47 mg/mL, followed by *Persicaria odorata* (C2) and *Mentha spicata* (C6). In the **Southern region**, *Parkia speciosa* Hassk

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(5), 1972-1977 | ISSN:2251-6727

(D2) demonstrated the highest phenolic content at 213.34 mg/mL, followed by Glochidion wallichianum Muell. Arg.(D6) and *Azadirachta indica* (D4).When compared nationwide, *Parkia speciosa* Hassk (D2) from the Southern region exhibited the highest phenolic content (213.34 mg/mL), followed by *Ocimum sanctum* (C3) from the Central region (122.47 mg/mL) and *Spondias pinnata* (B5) from the Northeastern region (110.30 mg/mL), respectively (Figure 6).

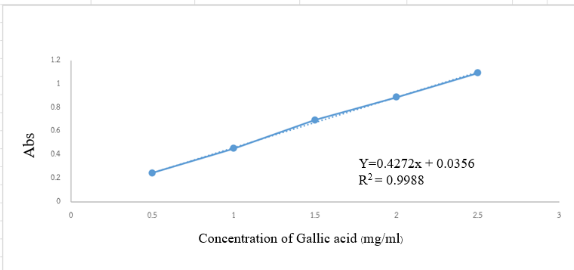

Figure 5. Relationship between absorbance and the concentration of gallic acid. Standard curve of gallic acid for the determination of total phenolic content. The calibration curve showed a correlation coefficient (R^2 = 0.9988), which is within the acceptable range.

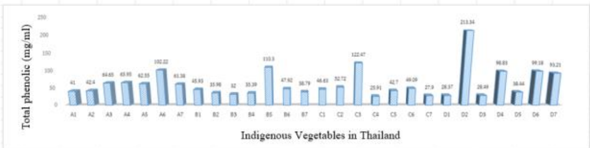

Figure 6. Overall total phenolic content of extracts from Thai indigenous vegetables.

5. Discussion

This study investigated the antioxidant activity and phenolic compound content of 28 indigenous vegetables collected from four regions of Thailand. The vegetables were extracted with 95% methanol, and their antioxidant activity was evaluated using the DPPH radical scavenging assay with Trolox as a standard. The results demonstrated significant variation in antioxidant capacity among species and across regions. These findings are consistent with the chemical rationale that polar solvents are effective in extracting polyphenols and flavonoids, which are key contributors to antioxidant activity. Similar outcomes have been reported in previous studies on lettuce extracts, where ethanol and methanol extractions yielded higher antioxidant activity compared with ethyl acetate after both 12 and 24 hours of extraction (13).

The DPPH radical scavenging assay further revealed that antioxidant capacities varied across regions when expressed in terms of Trolox Equivalent Antioxidant Capacity (TEAC). The highest activity in the Northern region was found in *Ocimum gratissimum* (A6, 114.37 mg/mL); in the Northeastern region, *Spondias pinnata* (B5, 137.46 mg/mL); in the Central region, *Ocimum sanctum* (C3, 198.95 mg/mL); and in the Southern region, *Curcuma longa* (D1, 153.06 mg/mL). These results support the concept that both “structural composition” and “quantitative composition” influence antioxidant activity. Extracts rich in hydroxyl (-OH) groups tend to exhibit stronger activity due to their ability to donate electrons and neutralize free radicals. This finding is in agreement with previous studies on the phytochemical composition and antioxidant activity of traditional Thai herbal formulations, where extracts of *Phyllanthus emblica* (Indian gooseberry) and *Terminalia bellirica* demonstrated differing levels of radical scavenging capacity (14). Likewise, studies on noni (*Morinda citrifolia*) extracts reported that crude ethanol extracts exhibited the strongest antioxidant activity with an EC_{50} value of 11.93 ± 0.04 mg/mL using the DPPH assay (15).

The analysis of total phenolic content using the Folin–Ciocalteu method, expressed as gallic acid equivalents, also showed significant variation across both species and regions. In the Northern region, *Ocimum gratissimum* (A6) recorded the highest phenolic content (102.22 mg/mL); in the Northeastern region, *Spondias pinnata* (B5, 110.30 mg/mL); in the Central region, *Ocimum sanctum* (C3, 122.47 mg/mL); and in the Southern region, *Parkia speciosa* Hassk (D2, 213.34 mg/mL). These differences can be attributed to several factors, including genetic composition, environmental conditions, and growth stage. Genotypic diversity among varieties influences their ability to synthesize phenolic compounds. Environmental factors such as light exposure, drought stress, plant diseases, and pest pressure may also enhance phenolic synthesis as a protective mechanism. Furthermore, phenolic content often fluctuates with developmental stages, with younger leaves or flowering stages generally exhibiting higher concentrations than mature tissues.

Overall, the findings confirm that many Thai indigenous vegetables are rich sources of phenolic compounds, which function as potent antioxidants.

Phenolic groups can stabilize free radicals by donating electrons, thereby interrupting oxidative damage pathways at the cellular level. The incorporation of these extracts into dietary supplements or functional beverages could therefore enhance antioxidant capacity in human blood and contribute to preventive health benefits (16).

Refrences

1. Haruthai T, Chadatip M, Salmira W, Pinyapat P, Sirinapa C. Total phenolic and flavonoid contents and antioxidant activities of *Piper sarmentosum* leaves, *Persicaria odorata* leaves, *Ocimum americanum* leaves, *Ocimum basilicum* leaves, and *Ocimum tenuiflorum* leaves. Thai J Public Health Health Sci. 2024;7(3). Available from: https://he02.tci-thaijo.org/index.php/tjph/issue/view/18480
2. Ridzuan P, Hairul Aini H, Mohd Hassan N, Hairul Aini H, Norazian MH, Shah A, Aminah KS. Antibacterial and antifungal properties of Persicaria odorata leaf against pathogenic bacteria and fungi. Proceedings Journal. 2013;Issue 4. Available from: https://www.researchgate.net/publication/348740094
3. Labadi K, Demmouche A, Sofiane B, Amara L, Brikhou S, Bouarfa A. Evaluation of the antioxidant and anti-inflammatory effect of *Moringa stenopetala* from the Algerian Sahara. J Chem Health Risks. 2024;14(6):2448–56.
4. Shahrajabian MH, Suna W, Cheng Q. Chemical components and pharmacological benefits of basil (*Ocimum basilicum*): A review. Int J Food Prop. 2020;23(1):1961–70. doi:10.1080/10942912.2020.1828456
5. Anek H, Boonyakrit R. Study on antioxidant efficiency of 15 species of indigenous vegetables and herbs. KMUTT J Res Dev. 2017;40(2):1–10.
6. Silva APS, Camargo AC, Lazarini JG, Franchin M, Sardi JCO, Rosalen PL, et al. Phenolic profile and the antioxidant, anti-inflammatory, and antimicrobial properties of açaí (*Euterpe oleracea*) meal: A prospective study. Foods. 2023;12(86). doi:10.3390/foods12010086
7. Ugwu EO, George BO, Omoike GO, Okpoghono J. Bioaccessibility of polyphenols and flavonoids in *Ocimum africanum* leaves extract. Uniport J Eng Sci Res. 2021;6(1):78–84. Available from: https://www.ujesr.org/images/vol6/Article-10.pdf
8. Azmi N, Zulkurnain EI, Ramli S, James RJ, Halim H. The phytochemical and pharmacological properties of *Persicaria odorata*: A review. J Pharm Res Int. 2021;33(41B):262–79. doi:10.9734/jpri/2021/v33i41B32366
9. Mbegbu JN, Nwajinka CO, Amaefule KU. Phenolic compounds and antioxidant activity of indigenous vegetables. J Food Biochem. 2021;45(8):e13839.
10. Singh D, Chaudhuri PK. A review on phytochemical and pharmacological properties of holy basil (*Ocimum sanctum* L.). Ind Crops Prod. 2018;118:367–82. doi:10.1016/j.indcrop.2018.03.048
11. Kiraman NAS, Yusof H. A mini review on the methods for the extraction, isolation, and determination of *P. odorata*'s bioactive compounds. Healthscope. 2022;5(2):38–44. Available from: https://ir.uitm.edu.my/id/eprint/70596/1/70596.pdf
12. Omoikea GO, Georgea BO, Ugwua EO, Okpoghono J. Changes in the antioxidant properties of *Ocimum africanum* leaves aqueous extract from the southeastern region of Nigeria after in vitro gastrointestinal digestion. Int J Food Prop. 2022;25(1):2000–8. doi:10.1080/10942912.2022.2120494
13. Inthachim T, Poomyai P. Study of antioxidant activity and total phenolic compounds from lettuce. In: Proceedings of the 4th National Conference, Research and Development Institute, Kamphaeng Phet Rajabhat University; 2017 Dec 22; Kamphaeng Phet, Thailand.
14. Tanchai K, Ratchawat P. Preliminary phytochemical constituents and antioxidant activities of herbal extracts in Amaritkawathi recipe. Bansomdejchaopraya Rajabhat Univ Res Inst J. 2024;9(1):99-108.
15. Naphat-orn B. Antioxidant activity and total phenolic content of crude extracts from *Morinda citrifolia* fruits. Valaya Alongkorn Rajabhat Univ J Sci Technol. 2020;15(2):31–8.
16. Pandey KB, Rizvi SI. Plant polyphenols as dietary antioxidants in human health and disease. Oxid Med Cell Longev. 2009;2(5):270-8.