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RELATIONSHIP BETWEEN PHENOLIC CONTENT AND ANTIOXIDANT CAPACITY IN SEVEN TRADITIONAL MEDICINAL PLANTS

Le Trung Hieu [1], Huynh Thi Ngoc Diep [2], Le Hoang Duy [3], Pham Cam Nam [4], Nguyen Minh Nhung [5], Le Lam Son [1], Tran Thi Van Thi [1]*

[1]Hue University of Sciences – Hue University, Department of Chemistry, 77 Nguyen Hue, Hue, Viet Nam,

2 Hue University of Agriculture and Forestry - Hue University, Faculty of Forestry, 102 Phung Hung, Hue, Viet Nam

3Pham Van Dong University, Department of Chemistry - Biological - Environment, 986 Quang Trung, Quang Ngai, Viet Nam

[4]The University of Da Nang – University of Science and Technology, Department of Chemistry – 54 Nguyen Luong Bang, Da Nang, Viet Nam,

[5]Technical Center for Quality Measurement Standards, Department of Science and Technology of Thua Thien Hue,26 Ha Noi, Hue, Viet Nam.

Abstract:

Antioxidant potential of seven medicinal plants through total phenolic content using Folin - Ciocalteu's method has been studied in which five phenolic compounds were quantified by HPLC and their antioxidant activity was evaluated using DPPH radical scavenging and total antioxidant activity methods. Moreover, the correlation between their total phenolic content and chemical compositions with total antioxidant capacity was also analyzed. The data resulted from DPPH radical scavenging activities indicated that they displayed the good activities with low IC_{50} values. Importantly, L. rubra had the highest activities, approximately 32 times less than that of curcumin. Basex on the total antioxidant activity and HPLC analysis, the antioxidant capacity of H. parasitica wass found the highest among seven medicinal plants. The amount of the five phenolic compounds is closely correlated with either total phenolic compounds or total antioxidant capacity. Obviously, phenolic compounds were significantly contributed to their antioxidant capacity. In addition, the amount of methyl gallate could be used as a Marker for the evaluation of the total antioxidant capacity or total phenolic content, s experimental showing that these medicinal plants are considered as new promising resources of natural antioxidants.

Keywords: *Microdesmis casearifolia, Helixanthera parasitica, Pyrostegia venusta, Spilanthes oleracea, Leea rubra, Archidendron clypearia, Archidendron bauchei, antioxidant activity*

Corresponding author:

Tran Thi Van Thi,

Hue University of Sciences – Hue University,
Department of Chemistry, 77 Nguyen Hue,
Hue, Viet Nam,
E-mail: tranthivanthi@gmail.com

QR code

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1. INTRODUCTION:

Seven traditional medicinal plants, which have been used by the Pako ethnic minority, Quang Tri Province, Vietnam to treat some infections symptoms (*e.g.* respiratory infections, pharyngitis, laryngitis, tonsillitis, burns, scalds and other types of wounds, scabies), are including *Archidendron bauchei*, *Archidendron clypearia, Microdesmis casearifolia, Helixanthera parasitica, Pyrostegia venusta, Spilanthes oleracea,* and *Leea rubra.* The previous phytochemical studies of *A. clypearia, H. parasitica*, *P. venusta*, *S. oleracea*, and *L. rubra* were reported that the isolation of many flavonoid compounds and acid derivaties [1-6] as the major components, which possess unique pharmacological effects like antibacterial, anticancer and antioxidant. However, the investigation of chemical compositions and evaluation of antioxidant activity of *A. bauchei* and *M. casearifolia* have not been reported elsewhere.

The reactive oxygen species (ROS), which are chemically reactive molecules containing oxygen such as $OH^{\bullet}$, $HOO^{\bullet}$, $O_2^{\bullet}$, etc., are high-energy and unstable molecules [7]. They easily attach to macromolecules in a body such as lipid, DNA, protein, etc. and cause serious diseases like cancer, cardiovascular disease, diabetes, obesity, and accelerated aging [7]. Thus, the antioxidant compounds are able to scavenge free radicals, slow down the aging process in the body, protect liver function and prevent certain health complications [7]. Therefore, finding medicinal plants possessing the strong antioxidative properties has emerged a significant attention.

Over past decades, the majority of the antioxidants were derived from plant sources and categorized to phenolic compounds, formed by one or more aromatic rings with one or more hydroxyl groups. The antioxidant capacity of phenolic compounds (ArOHs) were studied and clarified *via* three following antioxidant mechanisms [8], [9], [10] :

(i) Mechanism 1: Hydrogen atom transfer (HAT) from the antioxidant to the radical $ROO^{\bullet}$

(ii) Mechanism 2: Single Electron Transfer (SET) from the antioxidant to the radical leading to indirect H-abstraction

(iii) Mechanism 3: Sequential Proton Loss-Electron Transfer (SPLET)

They are several different methods to determine the antioxidant capacity [7],[11]. These methods differ in terms of their assay principle, experimental conditions and mechanism. The approach based on the stable free radical DPPH and total antioxidant capacity could be seen as the most effective way for the measurement of the antioxidant activity because of their fast and simple features. The DPPH radical scavenging activity determines the ability hydrogen atom transfer of the antioxidant compounds in the test samples. The total antioxidant activity of studied samples was assessed using the phospho-molybdenum method, which determines the electron transfer capability of the antioxidant compounds in the test sample.

Herein, we report the antioxidant potential of seven medicinal plants by evaluating total antioxidant capacity, DPPH radical scavenging and the total phenolic content. Moreover, experiments were also designed to quantify five phenolic compounds, to provide the correlation coefficients between antioxidant components and to find compound as a Marker for the evaluation of the total antioxidant capacity or total phenolic content.

2. EXPERIMENTAL SECTION:

2.1. Plant materials

The aerial parts of seven medicine plants were collected in March 2015 in Quangtri province of Vietnam and were taxonomically identified by the Institute of Marine Biochemistry, Viet Nam (IMBC). A voucher specimen was deposited at the Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology.

2.2. Preparation of methanol extracts

A dried sample (500 g) was extracted with 1.5 L methanol (MeOH) three times at room temperature. The solutions were combined, filtered through Whatman No. 4 paper and evaporated under reduced pressure at 50 ^{o}C, resulting of the crude methanol extract.

2.3. Evaluation of the total antioxidant activity using the phospho-molybdenum method

The total antioxidant activity of studied samples was assessed using the phospho-molybdenum method, which determines the electron transfer capability of the antioxidant compounds in the test sample. The total antioxidant activity of studied samples was determined according to the method described in literature [12] with certain modifications. In brief, a 0.3 mL aliquot of the sample was mixed with 3 mL of a reagent solution (0.6 M sulfuric acid, 28 mM sodium phosphate and 4 mM ammonium molybdate), and then the mixture was incubated at 95 ^{o}C for 90 min. The mixture was then cooled down to 25 ^{o}C and the absorbance was measured at the wave length of 695 nm against a blank that contained 3 mL of the reagent solution without the sample. The assay was performed in triplicate and the results were averaged. The total antioxidant activity was expressed as number of equivalents of gallic acid (GA) [13] and

ascorbic acid (AS) [14] (with concentrations of between 0.1 ÷ 0.5 mg/mL) and as the absorbance of the sample. The higher absorbance value indicates the higher antioxidant activity.

2.4. Evaluation of DPPH radical scavenging activity

The DPPH radical scavenging activity determines the hydrogen transfer capability of the antioxidant compounds in the test samples. The DPPH free radical scavenging activity of each sample was determined using the Jasco V-630 Spectrophotometer according to the method described by Gopi and coworkers [12] and Wong et al. [15] with certain modifications. The samples were dissolved in 1.5 mL methanol at various concentrations (25, 50, 75 and 100 µg/ mL) and mixed with 1.5 mL of 100 µM DPPH (100 µM DPPH dissolved in methanol before using). The reaction mixture was shaken for 1 minute and incubated at room temperature for 30 minutes. The absorbance was then measured at a wave length of 517 nm. Three milliliters of methanol was used as a blank sample. The DPPH radical scavenging activity (%) of the sample was calculated using the following formula.

$$SA_{\mathrm{DPPH}}(\%) = \frac{A_c - A_s}{A_c}.100$$

Where SA_{DPPH} (%) is the inhibition of DPPH activity; A_c is the optical density of the blank; A_s is the optical density of the sample.

All experiments were repeated three times to avoid errors. Radical scavenging activity was evaluated using the IC_{50} value [16], [17].

2.5. Total phenolic content

Total phenolic content was determined by the Folin - Ciocalteu. Typically, 0.5 mL of the methanolic extract solution was mixed with 2.5 mL of Folin - Ciocalteu (1:10) and 2 mL saturated Na_2CO_3 solution. The tubes were incubated 2 hours at room temperature for color development. Absorbance was then measured at 760 nm wavelength. Gallic acid was used to calculate the standard curve (with concentrations of between 0.05 ÷ 3 mg / mL) and the results were expressed as mg of gallic acid equivalents (GAE) per g of sample [15], [18].

2.6. Total flavonoid contents

The total flavonoid content was determined using the method of Meda et al. (2005) with minor modifications. Briefly, 1 mL of the methanolic extract solution was diluted by the mixture of 4 ml of deionized water and 0.3 mL of 5% $NaNO_2$. After 5 minutes, 0.3 mL of 10% $AlCl_3$ solution was added into above solution. Then, 2 mL of 1M NaOH solution was also added prior to be filled to 10 mL by deionized water. Absorbance was then measured at 510 nm wavelength. The total flavonoid content was determined using a standard curve of quercetin at 0–50 mg/mL. The results were expressed as quercetin equivalents (QE) on a dry weight (DW) basis [19].

2.7. HPLC conditions

Preparation of standard solutions

Methyl galate standard solutions were prepared in 10 mL methanol at 5 levels varied from 5 to 50 mg, rutin from 0.5 to 20 mg, quercetin from 5 to 20 mg, and quercetin from 0.5 to 10 mg.

Preparation of sample solutions

One hundred milligrams of given sample were accurately weighed and put into 10 mL volumetric flask prior to be dissolved by adding 10 mL of methanol to obtain 10 mg/mL sample solution.

Chromatographic conditions

Chromatographic analysis was carried out by C_{18} reversed phase Inertsil ODS-3 column (150 x 4.6 mm) packed by 5µm diameter particles, detector UV-Vis. The HPLC specification and chromatographic conditions are given in Table 7.

Table 1: HPLC specifications for phytochemical analysis

Compounds	methyl gallate	rutin	Quercetin	quercitrin	α-tocopherol
Mobile phase (v/v)	0.5% orthophosphoric acid (A): Methanol (B) (0 ~ 10 min, 10 → 25% A; 10 ~ 60 min, 25 → 47% A)			water (A) : acetonitrile (B) (0 ~ 20 min, 15% B → 25% B, 20 ~ 30 min, 25% B → 70%)	methanol: water (97:3)
Flow rate (mL/min)	1.0			1.0	1.2
Injection volume (µL)	20			10	20
Standard Rt (Min)	15.48 ± 0.12	38.33 ± 0.23	55.62 ± 0.42	15.03 ± 0.18	11.21 ± 0.11
Detection wavelength(nm)	370	370	370	370	295

All of the solutions and the mobile phases were filtered through a 0.45 µm membrane cellulose filter before used and all chromatographic operations were carried out at ambient temperature.

3. RESULTS AND DISCUSSION:

3.1. The antioxidant potential of seven medicinal plants

It was hypothesized in the previous studies that the antioxidant performance of a substance or mixture of substances may follow the mechanism of either hydrogen atom donor or electron donor or both [20]. However, each model evaluates just only one side of the antioxidant capacity. Therefore, for general looking we investigated the antioxidant activity of seven traditional medicinal plants regarding both hydrogen atom transfer and electron transfer mechanism.

3.1.1. Total antioxidant capacity

The total antioxidant capacity was determined by assessing the electron-donating capacity of the sample using the phospho-molybdenum method. In principle, this method based on the reduction of Mo(VI) to Mo(V) by the antioxidant compounds and the formation of a green Mo(V) complex at a low pH with a maximal absorbance at 695 nm. A high absorbance value indicates that the sample possesses high antioxidant activity [12].

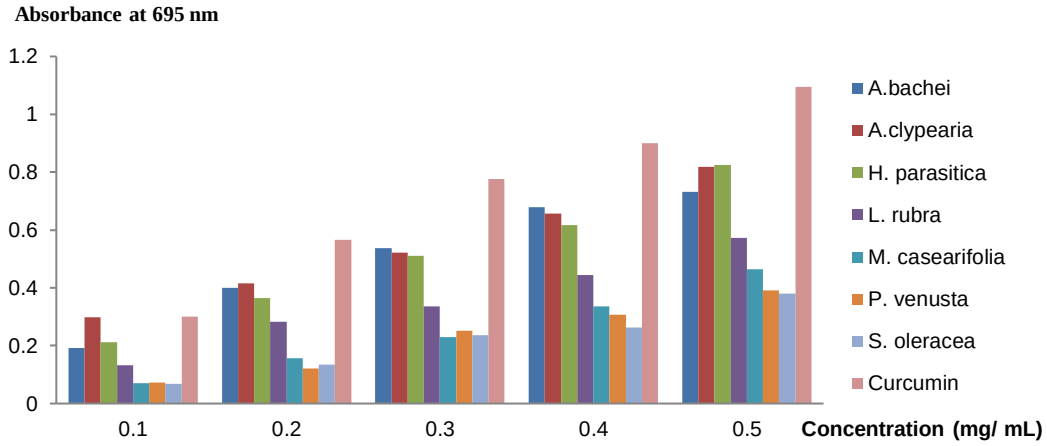

Fig. 1: **Antioxidant activity of methanolic extract from seven medicine plants**

As shown in Figure 1, all methanol extracts of seven medicinal plants exhibited a high total antioxidant activity in the electron transfer mechanims.However, their antioxidant activities were lower than that of curcumin. At low concentration (0.1 mg/mL), the methanol extract of *A. clypearia* showed the similar antioxidant activity as that in curcumin.

The antioxidant capacity was expressed in term of the number equivalents of gallic acid or ascorbic acid. The study revealed that the antioxidant capacity of the extracts enhanced with the increase of the plant extract concentration and the highest capacity was observed at the concentration of 0.5 mg/mL where total antioxidant capacity of seven medicine plants contained from 139.63 to 301.47 mg GA/g (in Table 1).

***Table 1*. Total phenolic contents (TPC), total flavonoid contents (TFC) and total antioxidant capacity (TAC) of seven medicine plants.**

Sample	TPC	TFC	TAC	
	(mg GA/g)	(mg QE/g)	(mg GA/g)	(µmol AS/g)
A. bauchei	24.35 ± 0.41	9.18 ± 0.18	233.30 ± 1.16	441.86 ± 1.12
A. clypearia	74.49 ± 1.08	24.40 ± 1.14	280.27 ± 1.32	530.81 ± 0.87
M. casearifolia	21.13 ± 0.40	11.16 ± 0.28	146.78 ± 1.15	277.99 ± 1.21
P. venusta	21.35 ± 0.43	9.06 ± 0.46	139.63 ± 1.11	264.45 ± 0.75
S. oleracea	18.17 ± 0.79	5.62 ± 0.12	143.72 ± 1.52	272.20 ± 1.14
L. rubra	16.66 ± 0.65	7.32 ± 0.17	200.09 ± 1.23	378.96 ± 1.32
H. parasitica	93.22 ± 0.34	71.69 ± 0.83	301.47 ± 1.68	570.97 ± 1.26

(*The standard curve equation of gallic acid: Abs = 0.7820 C_{GA} + 0.1648, R = 0.9966; and the standard curve equation of ascorbic acid: Abs = 4.5974 C_{AS} - 0.3231, R = 0.9952*)

All the extractions of seven medicine plants showed a significant total antioxidant capacity ranging from 264.45 to 570.97 µmol AS/g, which was significantly higher than sample grape seeds (from 233.2 to 337.1 µmol AS/g) [14]. Total antioxidant capacity (equivalent of gallic acid) of seven medicine plants was higher than that of *Piper betle* and tea [21].

3.1.2. DPPH radical scavenging activity

The values of DPPH radical scavenging activity is presented in Table 2.

Table 2: **The DPPH radical scavenging activity rates of seven medicine plants**

Concentration	*A. bauchei*	*A. clypearia*	*H. parasitica*	*L. rubra*	*M. casearifolia*	*P. venusta*	*S. oleracea*	Curcumin
100.0	95.35	89.72	89.15	96.71	59.20	54.60	65.67	81.26
20.0	85.96	78.15	70.21	94.32	52.31	51.13	56.90	40.64
4.0	74.29	15.73	32.16	82.07	51.13	43.79	54.89	29.07
0.8	15.70	2.17	2.35	45.46	38.19	37.42	31.18	20.19
IC_{50} (µg/mL)	2.67	12.78	11.50	1.20	3.72	17.53	3.34	38.50

It can be seen that the DPPH radical scavenging activities of methanol extracts of seven medicinal plants enhanced along with the increasing of concentration (in Table 2). The DPPH radical scavenging activity at the concentration of 100 µg/mL of *A. Bauchei* was higher than that of curcumin (81.26%) and other six plants.

It should be noted that antioxidant activity and capacity are often used interchangeably but they have different meanings. Activity refers to the the reaction conditions between a specific antioxidant and a specific oxidant whereas capacity is a measure of the amount of a given free radical scavenged by a sample [11]. From two mechanims to evaluate the antioxidant potential of seven medicinal plants, all extracts of seven medicinal plants exhibited a good antioxidant activity complying the hydrogen donor mechanism in which the DPPH free radical scavenging are significantly higher than that of curcumin. Importantly, the methanol extracts of *L. rubra* showed the highest activities accounting for 32 times than that of curcumin. Additionally, the data in Table 1 indicated that the total antioxidant capacity in *H. parasitica* (301.47 mg GA/g; 570.97 µmol AS/g) is the highest in seven medicinal plants.

3.2. Total phenolic and flavonoid contents

The antioxidant activity of medicinal plants were attributed by phenolic compounds [22]. The total phenolic content using the Folin-Ciocalteu's reagent was expressed in terms of gallic acid equivalent (the standard curve equation: A (Abs) = 10.5580 C_{GA} + 0.0633, R = 0,9993). The total phenolic content ranged from 16.66 to 93.22 mg GA/g. The highest content of phenolic compounds was found in *H. parasitica* (93.22 ± 0.34 mg GA /g), followed by *A. clypearia* (74.49 ± 1.08 mg GA /g) and *A. bauchei* (24.35 ± 0.41 mg GA /g), respectively.

Flavonoids are probably the most important natural phenolics. The relationship between structure and antioxidant activity of flavonoid systems has been extensively studied reported. Indeed, the antioxidant activity depends on the number and positions of hydroxyl groups, other substituents, and glycosylation of flavonoid molecules [23]. The content of flavonoids in the plant extracts was determined using the spectrophotometric method with aluminum chloride. The total flavonoid content was expressed in terms of quercetin equivalent (the standard curve equation: A (Abs) = 10.1620 C_{QU} + 0.0352, R = 0.9985). In this study, the content of flavonoids in plant extracts ranged from 5.62 to 71.69 mg QU/g. The total flavonoid content of *A. bauchei*, *A. clypearia*, *M. casearifolia*, *P. venusta*, *S. oleracea*, *L. rubra* and *H. parasitica* were found to be 9.18 ± 0.18, 24.40 ± 1.14, 11.16 ± 0.28, 9.06 ± 0.46, 5.62 ± 0.12, 7.32 ± 0.17 and 71.69 ± 0.83 mg QU/g, respectively. Specifically, the total phenolic content and flavonoid content of *H. parasitica*, *A. bauchei* and *M. casearifolia* has been reported for the first time.

It should be noted that seven medicinal plants in Quang Tri Province in Vietnam are the phenolic rich sources. The total phenolic and flavonoid contents were also compared with other medicinal plants, which are in either the same species or between species in the same genus mentioning in the literature. It can be seen that the total phenolic content of *A. clypearia* was 1.5 to 2.5 times higher than that of *A. dulce* [24], [13], however it was lower than that of *A. jiringa* [25]. While the total phenolic content of *S. oleracea* was 2.5 times higher than that the same species in Spain [3]. Also, the total flavonoid content of *P. venusta* was from 1.5 to 20 times higher than that of the same species in Mexico [26] and Brazil [27], respectively. The differences between phenolic and flavonoid contents could be

originated from the characteristics of the samples (e.g. soil, geographical location and weather conditions).

3.3. The content of selected phenolic compounds

Many great efforts has been devoted to find candidates from natural products to control radicals effectively. Phenolic compounds, including methyl gallate [28], rutin [29], quercetin [30], quercitrin [23] and *α*-tocopherol, were reported to exhibit radical scavenging activity. Therefore, they were chose and tested for their antioxidant activity in a DPPH radical scavenging assay. It can be seen that these five compounds showed strong antioxidant activities with low values of IC_{50} (see Table 3).

Additionally, the amount of these compounds is also important, which could help to explain the function of each component in the sample. Herein, we also developed the quantification method of these compounds by HPLC (see Table 4). The measured data indicated that the methods are valid according to the requirements for the determination of phenolic compound content including linearity and accuracy. The current methods also prove good linearity, with $R^2 > 0.999$ whereas the recoveries are located from 92.84 to 98.54%.

***Table 3*: The DPPH radical scavenging activity rates of fifteen isolated compounds**

serial number	compounds	DPPH radical scavenging activity at concentration				
		100	20	4	0.8	IC_{50} (µg/mL)
1	methyl gallate	99.08	97.16	80.12	48.48	1.95 ± 0.05
2	quercitrin	95.41	81.58	69.86	31.23	2.35 ± 0.14
3	rutin	93.12	85.14	40.23	20.14	7.48 ± 0.23
4	quercetin	98.72	85.16	75.52	48.23	1.93 ± 0.02
5	*α*-tocopherol	92.17	84.14	41.23	30.28	6.97 ± 0. 12

***Table 4:* Regression equation and recovery of methyl gallate, quercetin, rutin, quercitrin and *α*-tocopherol**

Serial number	Compounds	Regression equation	Regression Coefficient R^2	Recovery (%)
1	methyl gallate	y = 59648698.76x + 20722.99	1.000	96.23 ± 0.89
2	rutin	y = 27371495,33x + 15425.25	0.9999	98.54 ± 0.12
3	quercetin	y = 48417026.11x + 10,733.17	0.9999	95.59 ± 1.50
4	quercitrin	y = 42424607.90x - 373749.32	0.9993	96.99 ± 1.37
5	*α*-tocopherol	y = 1875.1x – 930.15	0.9992	92.84 ± 2.16

The distribution of the selected phenolic compounds is showed in Table 5. The high amount of methyl gallate, quercetin and *α*-tocopherol could be observed in all samples. The highest amount of methyl gallate and quercetin was found in the sample of *H. parasitica* and *A. bauchei*, respectively. While *α*-tocopherol is the majority component in *M. casearifolia*.

***Table 5:* Methyl gallate, quercetin, rutin, quercitrin and *α*-tocopherol contents from seven medicinal plants**

Sample	Methyl gallate (mg/g)	Rutin (µg/g)	Quercetin (mg/g)	Quercitrin (µg/g)	*α*-tocopherol (mg/g)	TA5C-(HPLC)* (mg/g)
A. bauchei	1.588 ± 0.014	45.976 ± 0.054	3.145 ± 0.049	0.017 ± 0.001	0.019 ± 0.001	4.798
A. clypearia	14.469 ± 0.133	86.895 ± 0.104	0.014 ± 0.001	9.891 ± 0.140	0.359 ± 0.008	14.939
M. casearifolia	0.229 ± 0.002	6.964 ± 0.008	2.427 ± 0.038	0.000	0.466 ± 0.011	3.129
P. venusta	0.157 ± 0.001	3.248 ± 0.004	0.007 ± 0.001	0.352 ± 0.005	0.251 ± 0.006	0.419
S. oleracea	0.574 ± 0.005	10.897 ± 0.013	0.008 ± 0.001	0.178 ± 0.002	0.026 ± 0.001	0.619
L. rubra	0.128 ± 0.001	152.311 ± 0.178	0.362 ± 0.006	0.004 ± 0.001	0.052 ± 0.001	0.694
H. parasitica	18.335 ± 0.001	41.876 ± 0.049	1.282 ± 0.020	7.241 ± 0.103	0.447 ± 0.011	20.113

Total amount of the selected phenolic compounds in seven medical plants can be arranged as follow: *H. parasitica* > *A. clypearia* > *A. bauchei* > *M. casearifolia* > *L. rubra* > *S. oleracea*. > *P. venusta*. This result is consistent with the experimental evaluation for total antioxidant capacity of seven medicinal plants in which three of them (i.e. *H. parasitica*, *A. clypearia*, and *A. bauchei*) showed the higher antioxidant activities in comparison to the rest of species.

From the amount of the phenolic compounds in the same species or between species mentioned in the literature, it can be seen that the phenolic contents in the studied plants are significantly higher than those reported [31][32] [33][34]. This indicates that seven medicinal plants in Quang Tri Province, Vietnam possess the strong antioxidant capacity.

3.4. The correlation between antioxidant components

Pearson correlation coefficient was used to evaluate the correlation between the components having antioxidant capacity, as shown in table 6 [35]. It can be seen that the Pearson correlations between the total antioxidant capacity and total phenolic content or between the total antioxidant capacity and total amount of the five phenolic compounds revealed quite high coefficients 0.8685 and 0.9019, respectively. Thus, it is evident that a close relationship exists between the total antioxidant capacity and total phenolic content, and total amount of the five phenolic compounds of seven medicinal plants that indicated significantly the contribution of phenolic compounds to total antioxidant capacity.

Table 6: **Pearson correlation coefficient of the component having antioxidant capacity**

Statistical Correlations	Regression equation	Pearson correlation coefficient R
TPC and TAC	y = 0.4071x - 45.5680	0.8685
TA5C-(HPLC) and TPC	y = 0.2480x - 3.1553	0.9886
TA5C-(HPLC) and TAC	y = 0.1060x - 15.505	0.9019
Methyl gallate and TPC	y = 0.2478x - 4.4688	0.9979
Methyl gallate and TAC	y = 0.1026x - 16.1200	0.8815
Rutin and TPC	y = 0.1759x + 42.9720	0.1030
Rutin and TAC	y = 0.3434x - 21.1540	0.4280
Quercetin and TPC	y = - 0.0040x + 1,1899	0.0980
Quercetin and TAC	y = 0.0022x + 0.5865	0.1131
Quercitrin and TPC	y = 0.1243x - 2.2554	0.9341
Quercitin and TAC	y = 0.0509x - 7.9767	0.8158
α- tocopherol and TPC	y = 0.0039x + 0.0828	0.6123
α- tocopherol and TAC	y = 0.0008x + 0.0574	0.2851

Also, relationship between the amount of five phenolic compounds and either the total antioxidant capacity or total phenolic content was established, as shown in table 6. The amount of methyl gallate and quercitrin were strongly correlated with total phenolic content and total antioxidant capacity with high coefficients from 0.8158 to 0.9979. Moreover, methyl gallate, which account for the highest amount of five phenolic, occurred in seven samples. For these reasons, the amount of methyl gallate could be used as a Marker for the evaluation of the total antioxidant capacity and total phenolic content.

4. CONCLUSIONS:

The studied results showed that seven medicinal plants in Quangtri, Vietnam inhibit the antioxidant activity with high capacity, which is equal or greater than those of other medicinal plants. *L. rubra* showed the highest activity which is approximately 32 times higher than that of curcumin while the highest antioxidant capacity in seven medicinal plants was found in *H. parasitica*. The close relationship, existing between the total antioxidant capacity and total phenolic content, or between the total antioxidant capacity and total amount of the five phenolic compounds, indicates the contribution of phenolic compounds to total antioxidant capacity. The amount of methyl gallate, which was strongly correlated with total phenolic content or total antioxidant capacity, could be used as a Marker for the evaluation of antioxidant activity in seven medicinal plants. For the first time, anitioxidant activity and capacity, total phenolic content and total amounts of the five phenolic compounds in seven medical plants has been reported and the experimental results showed that some medicinal plants are seen to be promising making new resources of natural antioxidants.

REFERENCES:

1.Pereira, Ana Maria S., et al. "Evaluation of anticandidal and antioxidant activities of phenolic compounds from Pyrostegia venusta (Ker Gawl.) Miers." *Chemico-biological interactions*, 2014;224: 136-141.

2.Ohashi, Kazuyoshi, et al. "Indonesian medicinal plants. XXV. Cancer cell invasion inhibitory effects of chemical constituents in the parasitic plant Scurrula atropurpurea (Loranthaceae)." *Chemical and pharmaceutical bulletin* , 2003);51.3: 343-345.

3.Navarro-González, Inmaculada, et al. "Nutritional composition and antioxidant capacity in edible flowers: characterisation of phenolic compounds by HPLC-DAD-ESI/MSn." *International journal of molecular sciences* ,2014; 16(1): 805-822.

4.Mamone, Leandro, et al. "Cytotoxic effects of Argentinean plant extracts on tumour and normal cell lines." *Cellular and Molecular Biology* 2011; 57(2):1487-99.

5.Op de Beck, Philippe, et al. "Antioxidant flavonoids and phenolic acids from leaves of Leea guineense G. Don (Leeaceae)." *Phytotherapy Research,2003;* 17(4): 345-347.

6.Phrutivorapongkul, Ampai, Aueporn Chaiwon Suwanna Vejabhikul, and Watcharee Netisingha Sunee Chansakaow. "An anesthetic alkamide and fixed oil from Acmella oleracea." *J Health Res,2008;* 22(2): 97-99.

7.Carocho, Márcio, and Isabel CFR Ferreira. "A review on antioxidants, prooxidants and related controversy: natural and synthetic compounds, screening and analysis methodologies and future perspectives." *Food and chemical toxicology,2013;* 51: 15-25.

8.Urbaniak, Alicja, Marcin Molski, and Małgorzata Szeląg. "Quantum-chemical calculations of the antioxidant properties of trans-p-coumaric acid and trans-sinapinic acid." *Comput. Methods Sci. Technol,2012;* 18: 117-128.

9.Leopoldini, Monica, et al. "Antioxidant properties of phenolic compounds: H-atom versus electron transfer mechanism." *The Journal of Physical Chemistry ,2004;A* 108(22): 4916-4922.

10.Leopoldini, Monica, et al. "Density functional computations of the energetic and spectroscopic parameters of quercetin and its radicals in the gas phase and in solvent." *Theoretical Chemistry Accounts,2004;* 111(2-6) : 210-216.

11.MacDonald-Wicks, Lesley K., Lisa G. Wood, and Manohar L. Garg. "Methodology for the determination of biological antioxidant capacity in vitro: a review." *Journal of the Science of Food and Agriculture,2006;* 86.13): 2046-2056.

12.Nair, Vadakkemuriyil Divya, Rajaram Panneerselvam, and Ragupathi Gopi. "Studies on methanolic extract of Rauvolfia species from Southern Western Ghats of India–In vitro antioxidant properties, characterisation of nutrients and phytochemicals." *Industrial Crops and Products,2012;* 39: 17-25.

13.Megala, J., and A. Geetha. "Free radical-scavenging and H+, K+-ATPase inhibition activities of Pithecellobium dulce." *Food chemistry* , 2010;121(4): 1120-1128.

14.Jayaprakasha, G. K., Tamil Selvi, and K. K. Sakariah. "Antibacterial and antioxidant activities of grape (Vitis vinifera) seed extracts." *Food research international* ,2003;36(2): 117-122.

15.Wong, Shih Peng, Lai Peng Leong, and Jen Hoe William Koh. "Antioxidant activities of aqueous extracts of selected plants." *Food chemistry, 2006;* 99(4): 775-783.

16.Huh, Man Kyu, Kyung-Soon Cho, and Sung-Jong Jeon. "Inhibitory effect of lipoxygenase and dpph radical scavening activity of Fraxinus rhynchophylla." *European Journal of Advanced Research in Biological and Life Sciences,2015; Vol* 3.3.

17.Brand-Williams, Wendy, Marie-Elisabeth Cuvelier, and C. L. W. T. Berset. "Use of a free radical method to evaluate antioxidant activity." *LWT-Food science and Technology, 1995;* 28(1): 25-30.

18.Gan, Ren-You, et al. "Antioxidant activity and total phenolic content of medicinal plants associated with prevention and treatment of cardiovascular and cerebrovascular diseases." *Journal of Medicinal Plants Research, 2010;* 4(22): 2438-2444.

19.Marinova, D., F. Ribarova, and M. Atanassova. "Total phenolics and total flavonoids in Bulgarian fruits and vegetables." *Journal of the university of chemical technology and metallurgy, 2005;* 40(3): 255-260.

20.Leopoldini, Monica, Nino Russo, and Marirosa Toscano. "The molecular basis of working mechanism of natural polyphenolic antioxidants." *Food Chemistry, 2011;* 125(2): 288-306.

21.Dasgupta, Nabasree, and Bratati De. "Antioxidant activity of Piper betle L. leaf extract in vitro." *Food chemistry, 2004;* 88(2): 219-224.

22.Pan, Yingming, et al. "Antioxidant activity of microwave-assisted extract of longan (Dimocarpus Longan Lour.) peel." *Food Chemistry*, 2008; 106(3): 1264-1270.

23.Materska, Małgorzata, and Irena Perucka. "Antioxidant activity of the main phenolic compounds isolated from hot pepper fruit (Capsicum annuum L.)." *Journal of Agricultural and Food Chemistry, 2005;* 53(5): 1750-1756.

24.Pal, Pabitra Bikash, et al. "Traditional extract of

Pithecellobium dulce fruits protects mice against CCl4 induced renal oxidative impairments and necrotic cell death." *Pathophysiology, 2012;* 19(2): 101-114.

25.Muslim, Nahdzatul Syima, et al. "Antiangiogenesis and antioxidant activity of ethanol extracts of Pithecellobium jiringa." *BMC complementary and alternative medicine, 2012;* 12(1): 210.

26.Establishment of callus from Pyrostegia venusta (Ker Gawl.) Miers and effect of abiotic stress on flavonoids and sterols accumulation

27.Altoé, Thales DP, et al. "In vitro antioxidant and cell viability of Pyrostegia venusta (Ker Gawl.) Miers." *Orbital: The Electronic Journal of Chemistry,2014;* 6(4): 215-222.

28.Asnaashari, Maryam, Reza Farhoosh, and Ali Sharif. "Antioxidant activity of gallic acid and methyl gallate in triacylglycerols of Kilka fish oil and its oil-in-water emulsion." *Food chemistry* ,2014;159: 439-444.

29.Yang, Jianxiong, Juan Guo, and Jiangfeng Yuan. "In vitro antioxidant properties of rutin." *LWT-Food Science and Technology* 41.6 (2008): 1060-1066.

30.Gordon, Michael H., and Andrea Roedig-Penman. "Antioxidant activity of quercetin and myricetin in liposomes." *Chemistry and Physics of Lipids* ,1998;97(1): 79-85.

31.LI, Xue-ling, et al. "HPLC determination of gallic acid and quercetin in different parts of Archidendron clypearia." *Chinese Journal of Experimental Traditional Medical Formulae,2010;* 18: 030.

32.Sultana, Bushra, and Farooq Anwar. "Flavonols (kaempeferol, quercetin, myricetin) contents of selected fruits, vegetables and medicinal plants." *Food Chemistry* ,2008;108(3): 879-884.

33.Toker, G., S. Turkoz, and N. Erdemoglu. "High performance liquid chromatographic analysis of rutin in some Turkish plants II." *Journal-Chemical Society Of Pakistan* , 1998;20:240-243.

34.Ching, Ling Soon, and Suhaila Mohamed. "Alpha-tocopherol content in 62 edible tropical plants." *Journal of Agricultural and food Chemistry,2001;* 49(6): 3101-3105.

35.Machu, Ludmila, et al. "Phenolic content and antioxidant capacity in algal food products." *Molecules,2015;* 20(1): 1118-1133.