One of the most important properties of disease prevention and cure for food or pharmaceutical purposes is their antioxidant activity. The chemically reactive oxygen species (ROS), containing oxygen such as OH·, HOO·, and $O_2^{\cdot}$, are the high-energy and unstable molecules. They tend to attach to macromolecules in the body, such as DNA, and protein, to cause diseases like cancer, cardiovascular disease, diabetes, obesity and ageing acceleration [24], [131]. Therefore, an additional amount of antioxidant to maintain the stability of the free radicals in the body is necessary for health protection. The antioxidative compounds are usually able to scavenge the free radicals, slowing down the ageing process in the body, protecting liver function and preventing some health complications: Alzheimer, Parkinson [63], [132], [90]...

One of the most important ways to detect bioactive compounds is from indigenous knowledge. The research will be based on the experience of using medicinal plants through biological screening, long-term accumulation and the impartation from one generation to another in the ethnic community. As thousands of *in vivo* tests on the human body over a very long period of time, it reduces time, effort and money compared to screening in the laboratory.From the survey of medicinal plants that Pako - Van Kieu people in Quang Tri province used to treat diseases related to antioxidant activities, such as pharyngitis, laryngitis, tonsillitis, burns, scalds and other types of wounds, scabies, Nguyen Thi Hoai and co-workers selected 16 medicinal herbs from 102 species, using the antioxidant activity screening method in the laboratory, from the results of the tests for antioxidation activity, the extracts of two medicinal plants in showed the strong antioxidant activity such as *Spilanthes oleracea* L. and *Archidendron clypearia.*

In addition, our initial studies revealed that the extracts of seven medicinal plants :*Archidendron bauchei, Archidendron clypearia, Microdesmis casearifolia, Helixanthera parasitica* Lour., *Pyrostegia Venusta* (Ker. Gawl.) Miers, *Spilanthes oleracea* L., *Leea rubra* Blume ex Spreng, showed a good activity with DPPH radical scavenging activities. However, the investigation of chemical components and evaluation of antioxidant activity of seven medicinal plants have not been reported elsewhere. Therefore, I chose the project to be my dissertation titled: "**A study on the chemical composition and antioxidant activity of some medicinal herbs of Pako and Bru - Van Kieu people, Quang Tri province".**

NEW CONTRIBUTIONS OF THESIS

1. For first time, the antioxidant activity - the hepatoprotective of seven medicinal plants and chemical compositions is evaluated by the combination of two chemical models, i.e. transfer electron and free radical scavenging, respectively combining with two biological models, which are *in vitro* on rat liver and *in vivo* in mice under the assisstance of computational chemistry. Thus, a close correlation was found between the antioxidant activity - the hepatoprotective on mice and the DPPH radical scavenging activity while the result from computational chemistry confirms the antioxidant activity following transfer hydrogen atom mechanism of the active substances in the medicinal plants.

2. *A. bauchei* possessed a good antioxidant activity with the IC_{50} values from the methanol extract is approximately 16 times lower than that of curcumin. All fractions of *A. bauchei* exhibited a good antioxidant activity following hydrogen donor mechanism in the DPPH and following the electron mechanism in total antioxidant capacity. Moreover, total phenolic content, total flavonoid content, the amount of

the five phenolic compounds, and total antioxidant capacity are significantly higher than either the studied plants or the reported publications.

3. For the first time, *A. bauchei* was investigated for its chemical composition and from this species, ten compounds have been isolated. Eight compounds out of them that were isolated from *Archidendron* for the first time.

4. The amount of the five phenolic compounds from seven medicinal plants have not been reported elsewhere. This indicates that seven medicinal plants in Quang Tri Province, Vietnam possess a strong antioxidant capacity.

5. The total content of five compounds are closely correlated with total phenolic compounds and total antioxidant. They significantly contribute to phenolic compounds for the antioxidant activities. Similarly, methyl gallate and quercitrin contents are strongly correlated with total phenolic compounds and total antioxidant. For these reasons, the methyl gallate and quercitrin contents could be used for the quick evaluation of the total phenolic compounds as well as the total antioxidant activity of the seven medicinal plants.

Therefore, the chemical composition, antioxidant activity- liver protection and the content of antioxidant activity of the seven traditional medicinal plants of the Pako peoplei.e. *A. bauchei*, *A clypearia*, *M. casearifolia*, *H. parasitica*, *P. venusta*, *S. oleracea* and *L. rubra* are studied systematically. *A. bauchei* and *M. casearifolia* have not been found in the literature in neither Vietnam nor the global scale.

STRUCTURE OF THESIS

The thesis includes 150 pages with 46 tables, 53 figures with 185 references. The structure of the thesis consists of the introduction (2

pages), the overview (36 pages), the research method and the experiment (24 pages), the results and the discussion (63 pages) concluding (3 pages), reference (15 page). There are also supplementary data and charts.

Chapter 1. OVERVIEW

1.1. Overview of antioxidant activity

1.1.1. Some concepts

1.1.2 Mechanism of antioxidant acitivity

1.1.3. Groups of natural compounds having antioxidant activity

1.1.4. Methods of evaluation of antioxidant activity

1.1.5. Total phenolic and flavonoid content

1.2. Overview of medicinal plants

1.2.1. Location of subspecies, distribution and characteristics

1.2.2. Chemical composition of the genus of seven medicinal plants

1.2.3. Biological properties of seven medicinal plants

1.3. Astract overview and the contents of the thesis

Chapter 2. RESEARCH AND EXPERIMENTAL METHODS

2.1. Plant Materials

The aerial parts of seven medicine plants: *Archidendron bauchei, Archidendron clypearia, Helixanthera parasitica, Leea rubra, Microdesmis casearifolia, Pyrostegia venusta, Spilanthes oleracea*.

2.2. Research objective

1. Evaluate the antioxidant activity of seven medicinal plants.

2. Develop processes for extracting and isolating compounds from medicinal plants.

3. Evaluate the antioxidant activities of isolated compounds.

4. Determine the content of compounds possessing antioxidant activities in seven medicinal plants.

2.3 Evaluation of antioxidant activity: Total antioxidant capacity, DPPH radical scavenging activity, bond dissociation enthalpies (BDE) through computational methods, antioxidant activity *in vitro* and *in vivo* on liver cells of mice.

2.4. Isolation, purification and structural identification of components: Thin layer chromatography, column chromatography, IR, UV-Vis, MS, 1D-NMR, 2D-NMR.

Using combined chromatographic methods, two compounds from water fraction, two compounds from ethyl acetate fraction and six compounds from chloroform fraction of the *A. bauchei* were isolated.

Similar, twelve compounds were isolated from *A. clypearia* including six compounds from chloroform fraction and six compounds from ethyl acetate fraction.

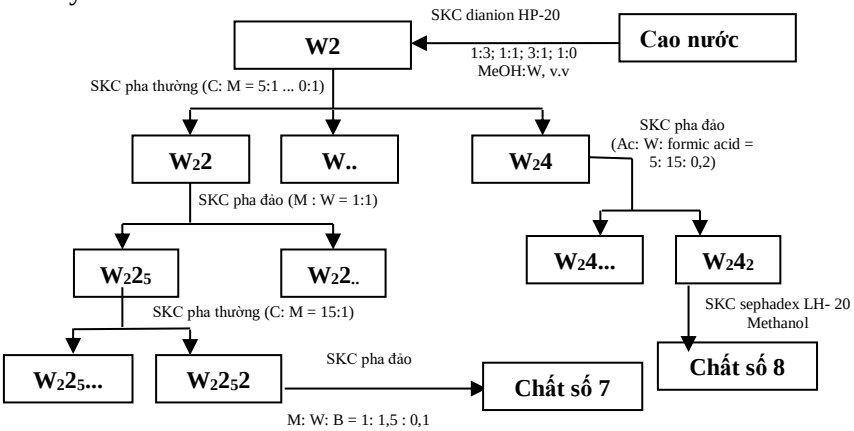

Figure 2.1. Isolation diagram of compounds N. **7** and N. **8**.

2.5. Quantification of components: HPLC

Chapter 3. RESULTS AND DISCUSSION

3.1. Antioxidant activity of seven medicinal plants

3.1.1. The antioxidant activity of the methanol extracts

3.1.1.1. The antioxidant activity of the methanol extracts in mechanism of electron donor

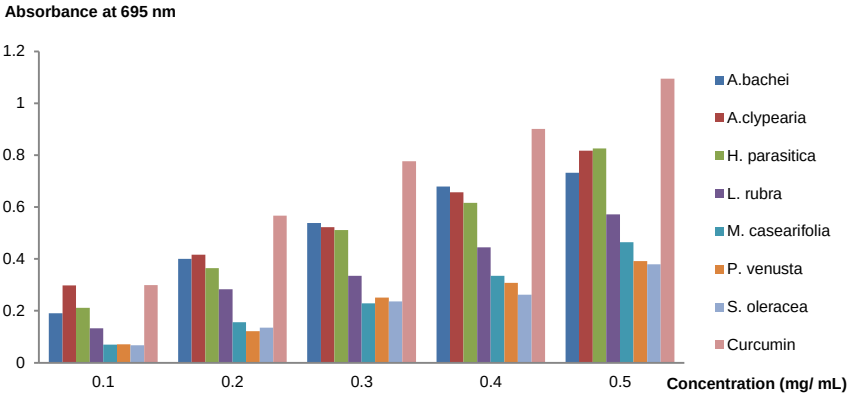

Fig. 3.1. Antioxidant activity of methanolic extract from seven medicine plants

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

The antioxidant capacity was expressed of as the number equivalents of gallic acid. 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.

3.1.1.1. The antioxidant activity of the methanol extracts in mechanism of hydrogen atom donor

All methanol extracts of seven medicine plants had shown good

activity with IC_{50} values between 1.20 ÷ 17.53 µg/mL (curcumin is 38.50 g/ mL). In particular, *A. bauchei* and *L. rubra* had the best activity with the lowest IC_{50} values (1.20 µg/mL and 2,67 µg/mL), being approximately 16 times lower than that of curcumin.

Through two models to evaluate potential antioxidant of selected seven medicinal plants that were used in the folk medicine in Vietnam – The Pako ethnic group for the treatment of diabetes, laryngitis, high blood pressure.With the strong antioxidant activity of seven medicinal plants opens prospects to studying in the chemical composition and biological activity.

3.1.2. Total phenolic and flavonoid contents

The total phenolic content ranged from 16.66 to 93.22 mg GA/g, the content of flavonoids in plant extracts ranged from 5.62 to 71.69 mg QU/g. Specifically, Both *A. bauchei* and *H. parasitica* contain the high amount of antioxidants, total phenolic content and total flavonoids content which are 3-4 times higher than that of the rest of species. It can be seen that the Pearson correlations between the total antioxidant capacity and total phenolic content revealed quite high coefficients 0.8685. Thus, total phenolic content could be used as a Marker for the evaluation of the total antioxidant capacity.

3.1.3. The antioxidant activity of fractions

3.1.3.1. Antioxidant capacity in mechanism of electron donor

The same of extraction, all fraction extracts of seven medicine plants exhibited lower antioxidant activity than curcumin in electron donor mechanisms. Especially, at high concentrations (0.4 ÷ 0.5 mg/mL), total antioxidant capacity of the water fraction of *A. bauchei* is higher than that of curcumin.

The four species of *A. bauchei*, *A. clypearia*, *H. Parasitica* and *S. Oleracea* have substance or mixture of substances may follow the

mechanism electron donor that focus on polarization fractions: ethyl acetate fracton and high water fraction; the other three species are concentrated in the less polarized fractions: *n*-hexane and chloroform.

3.1.3.1. Antioxidant capacity in mechanism of hydrogen atom donor

The same of extraction, all fraction extracts of seven medicine plants exhibited higher antioxidant activity than curcumin in hydrogen donor mechanisms, except for the *n*-hexane fraction of *H. parasitica*, *n*-butanol fraction of *M. casearifolia* and *n*-hexane fraction of *P. venusta* showed the less activity than curcumin. Notably, ethyl acetate fraction of *A. clypearia*, *n*-hexane of *L. rubra*, ethyl acetate and water fractions of *A. bauchei* exhibited higher antioxidant activities, which is approximately 16 times lower than that of curcumin.

3.1.3.3. Antioxidant hepatoprotective in in vitro assay

Through two models to evaluate potential antioxidant, the ethyl acetate fraction of *A. clypearia* showed the best antioxidant activity to DPPH free radical scavenging with the lowest IC_{50} value, which is approximately 22 times lower than that of curcumin. This fraction contains the best compounds possessing electron donor feature in the chemical *in vitro* test. Moreover, it also revealed a low ED_{50} value (0.63 μg/mL) in comparison to curcumin (4.43 μg/mL) in the *in vitro* bioassay.

3.1.3.3. Antioxidant hepatoprotective in in vivo assay

Additionally, it clearly showed good protection towards *in vitro* liver cells at the doses of 500 and 1000 mg/kg/day while the efficient is similar to silymarin (50 mg/kg/day) at the doses of 2000 mg/kg/day.

Conclusion of section 3.1.

Methanol extracts and all fractions of seven medicine plants exhibited lower antioxidant activity than curcumin in electron donor mechanisms but exhibited a good antioxidant activity obeying the

hydrogen donor mechanism in the DPPH free radical scavenging with IC_{50} values from 1.20 to 17.53 μg/mL, which are strongly roughly 2 ÷ 32 times curcumin (38.50 μg/mL).

Through two models to evaluate potential antioxidant, the methanol extraction and all fractions of *A. bauchei* and *A. clypearia* showed higher antioxidant activities than curcumin and the other five species. The experimental results showed that ethyl acetate fraction of *A. clypearia* seen to be correlations between hydrogen donor mechanisms in model DPPH, and antioxidant hepatoprotective *in vitro* assay or *in vivo* assay, and higher antioxidant activities than curcumin.

For these reasons, selected *A. bauchei* and *A. clypearia to* develop processes for extracting and isolating compounds, selected hydrogen donor mechanisms in model DPPH to evaluation of antioxidant activity of compounds isolated and quantification of components in seven medicine plants.

3.2. Compounds from *A. bauchei* and *A. clypearia*

3.2.1. Compound N⁰.1: lup-20(29)-en-3-one, was isolated from *Archidendron* for the first time

Compound N⁰.**1**: as a white powder, soluble in $CHCl_3$. ^{1}H-NMR (500 MHz, $CDCl_3$) δ_H 1.08 (*s*, H-23/H-26), 1.03 (*s*, H-24), 0.93 (*s*, H-25), 0.96 (*s*, H-27), 0.80 (*s*, H-28), 4.57 (*s*, H-29a), 4.70 (*s*, H-29b), 1.69 (*s*, H-30). ^{13}C-NMR (125 MHz, $CDCl_3$) δ_C (ppm): 39.6 (C-1), 34.1 (C-2), 218.2 (C-3), 47.4 (C-4), 55.0 (C-5), 19.3 (C-6), 33.6 (C-7), 40.8 (C-8), 49.8 (C-9), 36.9 (C-10), 21.5 (C-11), 25.2 (C-12), 38.2 (C-13), 42.9 (C-14), 27.5 (C-15), 35.5 (C-16), 43.0 (C-17), 48.3 (C-18), 48.0 (C-19), 150.9 (C-20), 29.9 (C-21), 39.6 (C-22), 26.7 (C-23), 21.1 (C-24), 16.0 (C-25), 15.8 (C-26), 14.5 (C-27), 18.0 (C-28), 109.4 (C-29), 19.7 (C-30).

3.2.2. Compound N⁰.2: **α-tocospiro A,** was isolated from *Archidendron* for the first time.

Compound N^0.**2**: as a white oil, soluble in CH_3COCH_3. ^{1}H-NMR (500 MHz, $CDCl_3$) δ_H (ppm): 2.02 (*s*, H-3a), 1.82 (*s*, H-5a), 1.83 (*s*, H-6a), 1.05 (*s*, H-9a), 0.85 (*d*, 7,0, H-13), 0.84 (*d*, 6.5, H-17a), 0.87 (*d*, 7.0, H-21a/H-22), 4.17 (*s*) (-OH). ^{13}C-NMR (125 MHz, $CDCl_3$) δ_C (ppm): 204.9 (C-1), 92.2 (C-2), 207.1 (C-3), 24.9 (C-3a), 89.1 (C-4), 163.0 (C-5), 11.8 (C-5a), 139.3 (C-6), 8.7 (C-6a), 32.9 (C-7), 36.2 (C-8), 87.0 (C-9), 25.5 (C-9a), 41.5 (C-10), 22.5 (C-11), 37.3 – 37.6 (C-12, C-14, C-16, C-18), 32.7 (C-13), 32.8 (C-17), 19.7 (C-13a), 19.8 (C-17a), 24.8 (C-15), 24.5 (C-19), 39.4 (C-20), 28.0 (C-21), 22.7 (C-21a), 22.6 (C-22).

3.2.3. Compound N^0.3: **spinasterol,** was isolated from *Archidendron* for the first time.

Compound N^0.**3**: as a white powder, soluble in $CHCl_3$. ^{1}H-NMR (500 MHz, $CDCl_3$) δ_H (ppm): 5.15 (*brs*, H-7), 1.03 (*d*, 6.5, H-21), 0,85 (*d*, 6.5, H-26), 0.81 (*d*, 6.0, H-27), 0.81 (*t*, 7.0, H-29), 0.80 (*s*, H-19), 0.55 (*s*, H-18), 3.59 (*m*, H-3), 5.17 (*dd*, 9.0, 15.0, H-22), 5.03 (*dd*, 8.5, 15.0, H-23). ^{13}C-NMR (125 MHz, $CDCl_3$) δ_C (ppm): 37.2 (C-1), 31.5 (C-2), 71.1 (C-3), 38.0 (C-4), 40.3 (C-5), 29.7 (C-6), 117.5 (C-7), 139.6 (C-8), 49.5 (C-9), 34.2 (C-10), 21.6 (C-11), 39.5 (C-12), 43.3 (C-13), 55.1 (C-14), 23.0 (C-15), 28.5 (C-16), 55.9 (C-17), 12.1 (C-18), 13.0 (C-19), 40.8 (C-20), 21.4 (C-21), 138.2 (C-22), 129.5 (C-23), 51.3 (C-24), 31.9 (C-25), 21.1 (C-26), 19.0 (C-27), 25.4 (C-28), 12.3 (C-29).

3.2.4. Compound N^0.4: oleanolic acid, was isolated from *A. bauchei* for the first time.

Compound N^0.**4:** as a white powder, soluble in $CHCl_3$. ^{1}H-NMR (500 MHz, $CDCl_3$) δ_H (ppm): 1.16 (*s*, H-27), 0.98 (*s*, H-23), 0.96 (*s*, H-30), 0.92 (*s*, H-29), 0.90 (*s*, H-25), 0.77 (*s*, H-24), 0.74 (*s*, H-26), 2.82 (*d*, H-18), 5.27 (H-12), 3.22 (*dd*, 11.5, 4.0, H-3). ^{13}C-NMR (125 MHz, $CDCl_3$) δ_C (ppm): 38.3 (C-1), 27.3 (C-2), 79.2 (C-3), 38.5 (C-4), 55.4 (C-5), 18.4 (C-6), 32.7 (C-7), 39.4 (C-8), 47.8 (C-9), 37.2 (C-10), 23.0 (C-11), 122.8 (C-12), 143.7 (C-13), 41.7 (C-14), 27.8 (C-15), 23.5 (C-16), 46.7 (C-17), 41.1 (C-18), 46.0 (C-19), 30.8 (C-20), 33.9 (C-21), 32.6 (C-22), 28.2 (C-23), 15.7 (C-24), 15.5 (C-25), 17.3 (C-26), 26.1 (C-27), 183.7 (C-28), 33.2 (C-29), 23.7 (C-30).

3.2.5. Compound N^0.5: daucosterol, was isolated from *Archidendron* for the first time.

Compound N^0.**5**: as a white powder, soluble in $CHCl_3$: CH_3OH = 2:1, v/v). ^{1}H-NMR ($CDCl_3$ + CD_3OD, 500 MHz) δ_H (ppm): 4.41 (*d*, 7.5, H-1'), 3.26 (m, H-2'), 3.30 – 3.47 (m, H-3'/ H-4'/ H-5'), 3.76 (*dd*, 5.0, 12.0, H-6'a), 3.84 (*dd*, 3.0, 12.0, H-6'b), 3.58 (*m*, H-3), 5.37 (*d*, 5.0, H-6), 0.69 (*s*, H-18), 1.01 (*s*, H-19), 0.93 (*d*, H-21), 0.82 (*d*, H-26), 0.83 (*d*, H-27), 0.85 (*t*, H-29).

3.2.6. Compound N^0.6: metyl gallate, was isolated from *A. bauchei* for the first time.

Compound N^0.**6**: as a white crystal, soluble in CH_3COCH_3, mp: 201.2 – 202.5 ^{o}C, M= 184.0. ^{1}H-NMR (500 MHz, CD_3OD) δ (ppm): 7.07 (2H, s, H-2 & H-6), 3.83 (3H, s, H-8).^{13}C-NMR (125 MHz, CD_3OD) δ (ppm): 169.0 (s, C-7), 146.4 (s, C-3 & C-5), 139.7 (s, C-4), 121.5 (s, C-1), 110.1 (d, C-2 & C-6), 52.2 (q, C-8).

3.2.7. Compound N^0.7: quercetin, was isolated from *A. bauchei* for the first time.

Compound N^0.**7:** as a yellow crystalline solid, mp: 315.4 – 316.8 ^{0}C, M= 302.05. ^{1}H-NMR (DMSO-d6, 500 MHz) *δ*: 12.48 (1H, *s*, 5-OH), 7.68 (1H, *d*, 2.5, H 2'), 7.54 (1H, *dd*, 2.0, 6.5, H-6'), 6.89 (1H, *d*, 8.5, H-5'), 6.41 (1H, *d*, 2.0, H-8), 6.19 (1H, *d* , 2.0, H-6). ^{13}C-NMR (125 MHz, DMSO-d6) δ (ppm): 146.9 (C-2), 135.8 (C-3), 175.9 (C-4), 160.8 (C-5), 98.3 (C-6), 163.9 (C-7), 93.4 (C-8), 156.3 (C-9), 103.1 (C-10), 122.1 (C-1'), 115.2 (C-2'), 145.2 (C-3'), 147.8 (C-4'), 115.7 (C-5'), 120.1 (C-6').

3.2.8. Compound N^0.8: rutin, was isolated from *A. bauchei* for the first time.

Compound N^0.**8:** as yellow amorphous powder form, soluble in CH_3OH, mp: 194.5 – 195.8 ^{0}C, M= 610.16. ^{1}H-NMR (DMSO-d6, 500 MHz) δ_H (ppm): 7.55 (1H, *d*, 2.0, H-6'), 7.53 (1H, *d*, 2.5, H-5'); 6.83 (1H, *d*, 2.0, H-2'), 6.36 (1H, *s*, H-8) and 6,16 (1H, *d*, 1.0, H-6), 5.32 (*t*, 3.5, H-1''), 4.39 (*s*, H-1'''), 0.99 (*d*, 6.0, H-6'''). ^{13}C- NMR (125 MHz, DMSO-d6) δ (ppm): 156.2 (C-2), 133.2 (C-3), 177.2 (C-4), 161.1 (C-5), 98.9 (C-6), 165.1 (C-7), 93.7 (C-8), 156.2 (C-9), 103.5 (C-10), 121.0

(C-1'), 115.2 (C-2'), 144.8 (C-3'), 148.6 (C-4'), 116.1 (C-5'), 121.6 (C-6'), 101.3 (C-1"), 74,1 (C-2"), 76.5 (C-3"), 70.5 (C-4"), 75.9 (C-5"), 67.0 (C-6"), 100.7 (C-1"'), 70.3 (C-2"'), 70.0 (C-3"'), 71.9 (C-4"'), 68.2 (C-5"'), 17.7 (C-6"').

3.2.9. Compound N⁰.9: α-tocopherol, was isolated from *Archidendron* for the first time.

Compound N⁰.**9**: isolated in the form of oil, white, soluble in CH_3COCH_3. ^{1}H-NMR (500 MHz, $CDCl_3$) δ_H (ppm): 1.23 (*s*, H-2a), 1.78 (*m*, H-3), 2.60 (*t*, 7.0, H-4), 2.11 (*s*, H-5a/H-8b), 2.16 (*s*, H-7a), 1.54 (*m*, H-1'), 1.41 (*m*, H-1'), 1.43 (*m*, H-2'), 1.92 (*m*, H-6'), 1.28 (*m*, H-10'), 1.05 (*m*, H-11'), 1.53 (*d*, 6.5, H-12'), 0.87 (*d*, 6.5, H-12'a/ H-13'). ^{13}C-NMR (125 MHz, $CDCl_3$) δ_c (ppm): 74.5 (C-2), 23.8 (C-2a), 31.6 (C-3), 20.8 (C-4), 117.4 (C-4a), 118.5 (C-5), 11.3 (C-5a), 144.5 (C-6), 121.0 (C-7), 12.2 (C-7a), 122.6 (C-8), 145.6 (C-8a), 11.8 (C-8b), 39.8 (C-1'), 21.1 (C-2'), 37.3 – 37.5 (C-3', C-5', C-7', C-9'), 32.8 (C-4', C-8'), 19.8 (C-4'a, C-8'a), 24.5 (C-6'), 24.8 (C-10'), 39.4 (C-11'), 28.0 (C-12'), 22.6 (C-12'a), 22.7 (C-13').

3.2.10. Compound N⁰.10: betulinic acid, was isolated from *Archidendron* for the first time.

Compound N⁰.**10**: as white powder, soluble in $CHCl_3$. ^{1}H-NMR (500 MHz, $CDCl_3$) δ_H (ppm): 3.17 (*dd*, 6.0, 10.5, H-3), 0.96 (*s*, H-23), 0.75 (*s*, H-24), 0.82 (*s*, H-25), 0.94 (*s*, H-26), 0.97 (*s*, H-27), 4.60 (*s*, H-29), 4.73 (*s*, H-29), 1.69 (*s*, H-30). ^{13}C-NMR (125 MHz, $CDCl_3$) δ_C (ppm): 38.9 (C-1), 27.2 (C-2), 79.0 (C-3), 38.8 (C-4), 55.5 (C-5), 18.4 (C-6), 34.5 (C-7), 40.8 (C-8), 50.7 (C-9), 37.3 (C-10), 21.0 (C-11), 25.7 (C-12), 38.4 (C-13), 42.6 (C-14), 30.7 (C-15), 32.4 (C-16), 56.4 (C-17), 47.1 (C-18), 49.2 (C-19), 150.9 (C-20), 29.8 (C-21), 37.3 (C-22), 28.0 (C-23), 15.4 (C-24), 16.1 (C-25), 16.0 (C-26), 14.8 (C-27), 179.4 (C-28), 109.6 (C-29), 19.4 (C-30).

3.2.11. Compound N⁰.11: α-spinasterone, was isolated from *Archidendron* for the first time.

^{1}H-NMR (500 MHz, $CDCl_3$) δ_H (ppm): 0.58 (*s*), 1.02 (*s*) with four methyl groups in the atria 1.03 (*d*, 8.5), 0.82 (*dd*, 4.5, 7.5), 0.85 (*d*, 8.0), 0.79 (*m*). ^{13}C-NMR (125 MHz, $CDCl_3$) δ_C (ppm): 38.8 (C-1), 38.1 (C-2), 212.0 (C-3), 44.3 (C-4), 42.9 (C-5), 30.1 (C-6),

117.0 (C-7), 139.5 (C-8), 48.9 (C-9), 34.4 (C-10), 21.7 (C-11), 39.4 (C-12), 43.3 (C-13), 55.1 (C-14), 23.0 (C-15), 28.5 (C-16), 55.9 (C-17), 12.1 (C-18), 12.5 (C-19), 40.8 (C-20), 21.4 (C-21), 138.1 (C-22), 129.6 (C-23), 51.3 (C-24), 31.9 (C-25), 19.0 (C-26), 21.1 (C-27), 25.4 (C-28), 12.2 (C-29).

3.2.12. Compound N^0.12: stigmasterol

Compound N^0.**12:** as colorless crystals, mp: 155 - 157 ^{o}C. ^{1}H-NMR δ_H 5.18 (*m*, H-6), 5.16 (*m*, H-22), 5.03 (1H, *dd*, H-23).

3.2.13. Compound N^0.13: 1-octacosanol

Compound N^0.1**3** was obtained as a white powder, soluble in chloroform with a molecular formula of $C_{28}H_{58}O$ from a pseudo molecular ion peak m/z 413.0 $[M+H]^+$. The ^{1}HNMR spectrum showed the presence signal of the methyl group at δ_H 10.88 (t, J = 7.0Hz, H-28), oxymethylene group at δ_H 3.64 (t, J = 7.0 Hz, H-1), a methylene group adjacent oxymethylene group at δ_H 1.57 (H-2) and other proton parafinic during δ_H 1.25 to 1.34 (H-3H-27). These data along with spectral data in document [27] allows confirming the compound N^0.**13** is 1-octacosanol.

3.2.14. Compound N^0.14: docosenoic acid

Compound N^0.1**4** was isolated as an oil, colorless, soluble in chloroform with a molecular formula of $C_{22}H_{42}O_2$ from a pseudo molecular ion peak m/z 337.6 [M-e]+. The ^{1}H-NMR spectrum showed the presence of one methyl at δ_H 0.88 (t, J = 7.0 Hz), three methylene groups δ_H at 1.63, 2.00, 2.34 (t, J = 7.5), olefinic proton at δ_H 5.34 (m) and signals of methylene groups during 1.14 to 1.42. Signals from olefinic protons appear as a Constantine reaction multiplet with little proven double bond cis configuration. The ^{13}C-NMR and DEPT spectrum showed the presence of carboxyl group at δ_C 180.3; double bond of two carbon at 130.0 and 129.7, one methyl group at 14.1 and many methylene groups. The spectral data

indicates the compound N^0.1**4** as a fatty acid with one double bond. Compound N^0.**14** was identified as docosanoic acid.

3.2.15. Compound N^0.15: quercetin 3-O-α-L-rhamnopyranoside

Compound N^0.**15**: as a light brown amorphous powder M= 448,1. ^{1}H-NMR (500 MHz, CD_3OD) δ_H (ppm): 6.21 (*d*, 2.0, H-6), 6.38 (*d*, 2.0, H-8), 7.35 (*d*, 2.0, H-2'), 6.93 (*d*, 8.0, H-5'), 7.32 (*dd*, 2.0, 8.0, H-6'), 5.37 (*d*, 1.5, H-1''), 4.24 (*m*, H-2''), 3.77 (*dd*, 3.5, 9.5, H-3''), 3.36 (*d*, 9.5, H-4''), 3.44 (*m*, H-5''), 0.96 (*d*, 6.5, H-6''). ^{13}C-NMR (125 MHz, CD_3OD) δ_C (ppm): 159.3 (C-2), 136.2 (C-3), 179.6 (C-4), 163.2 (C-5), 99.8 (C-6), 165.8 (C-7), 94.7 (C-8), 158.5 (C-9), 105.9 (C-10), 123.0 (C-1'), 117.0 (C-2'), 146.8 (C-3'), 149.8 (C-4'), 116.4 (C-5'), 122.9 (C-6'), 103.5 (C-1''), 71.9 (C- 2''), 72.1 (C-3''), 73.3 (C- 4''), 72.0 (C- 5''), 17.6 (C- 6'').

3.2.16. Compound N^0.16*: 7-O-Galloyltricetiflavan

Compound N^0.**16** was isolated as a light brown amorphous powder, soluble in methanol. Its molecular formula was established as $C_{22}H_{18}O_{10}$ by ESI-MS and it exhibited a pseudo molecular ion [M-H$^-$] at *m/z* 440.7 (calculated 442.4). The ^{1}H NMR and ^{13}C NMR signals of compound N^0.**15** were assigned according to their chemical shifts and coupling constants, as well as 2D-NMR spectra, especially HMBC analysis. In the ^{1}H NMR and ^{13}C NMR spectra of compound N^0.**15** signals at δ_H 1.96, 2.18 and 4.82 and signals at δ_C 20.36, 30.77, and 79.05 indicated the presence of two methylene groups and one oxygenated methine group. In the ^{13}C-NMR spectrum, the presence of 11 aromatic quaternary carbon signals at δ_C 157.3 (s), 151.4 (s), 157.7 (s), 108.6 (s), 133.7 (s), 146.6 (s), 134.1 (s), 120.8 (s), 146.9 (s), 140.4 (s), and 167.1 (s) suggested that the structure of compound N^0.**15** contained three aromatic groups and one ester group. In the ^{1}H-NMR spectrum, four aromatic proton signals at δ_H 6.19 (1H, d, 2.0), 6.21 (1H, d, 2.0), 6.45 (2H, s), and 7.19 (2H, s) indicated that there was a pair of *meta*-coupled protons. The HMBC showed

correlations from H-2'' and H-6'' to C-1'', C-4''and C-7'', and H-2' and H-6' to C-1' and C-4', and a long spin system H-2''/C-3'', H-6''/C-5'', H-2'/C-3' and H-6'/C-5' established was a galloyl - substituted flavan. Based on the NMR data and compared with the given data in the references, the structure of compound N^0.**15** was identified as 7-O-Galloyltricetiflavan.

Conclusion of section 3.2. From two species of *A. bauchei* and *A. clypearia* isolated and determined the chemical structure of 16 compounds, of which 8 were first isolated from *Archidendron. A. bauchei* was investigated for its chemical composition and from this species had isolated ten compounds.

3.3. Antioxidant activity of isolated compounds

3.3.1. In the DPPH model

The substances can be divided into two main groups: the first group was composed by six substances with higher values of antioxidant activity in this group, the highest values were observed for quercetin followed by methyl gallate, quercetin-3-O-α-L-rhamnopyranoside, quercetin, rutin, α-tocopherol, and 7-O-galloyltricetiflavan. The second group was composed by ten substances with lower antioxidant activity including daucosterol, betulinic acid, lup-20(29)-en-3-one, α-tocospiro A, α-spinasterol and stigmasterol,...

3.3.2. The correlation between DPPH radical scavenging activity and antioxidant activity *in vitro* assay

Six pure compounds of the two groups (DPPH model) were selected to evaluation of antioxidant activity - protection of the liver. Among the sĩ compounds: 7-O-galloyltricetiflavan had the best activity with the lowest IC_{50} values (1.02 µg/mL, being approximately 6 times lower than that of curcumin. Methyl gallate and quercitrin had shown a good

antioxidant with value ED_{50} of 7.31 µg/mL and 30.64 µg/mL, respectively (for curcumin was 6.31 µg/mL). Three compounds of daucosterol, 1-octacosanol and docosenoic acid expressed lower antioxidant effects in the experimental model.

At 20 µg/mL and 100 µg/mL concentration, the experimental results showed that the evaluation of the antioxidant ability based on the chemical (DPPH) and the biological model (antioxidant protection of the liver *in vitro* on rat liver) is completely compatible.

3.3.3. Confirm the antioxidant mechanism of the isolated compounds by computational chemistry

In addition, based on the determination from the experimental values, computational study was also performed to prove and demonstrate the antioxidant capacity of methyl gallate, quercitrin, rutin and quercetin.

3.3.3.1. Investigation of the O-H linkage energy calculation method

In order to estimate the antioxidants *via* HAT mechanism, the bond dissociation enthalpied of the O-H bond need to be acurately calculated. It shoud be noted that there are two conformations of methyl gallate **,** the structure on the right of Figure 2 is stable than the preceding one about -11.99 kcal/mol. Therefore, all calculations for BDE(O-H) in methyl gallate were based on this structure.

Concerning to BDE(O-H) calculations, two computational methods were proposed to compare with each other. In this context, the optimization task combined with frequency calculation for the first and second computational methods were carried out at the PM6 and B3LYP/6-31g(d), respectively. Then, based on these optimized structures, the energy at higher level of chemistry *i.e.* B3LYP/6-

311++G(2d,2p) and B3LYP/6-311++G(2df,2p) methods were calculated.

Table 3.1. The predicted BDE(O-H)s of methyl gallate **(**kcal/mol) calculated at B3LYP/6-311++G(2d,2p)//PM6 and B3LYP/6-311++G(2df,2p)//B3LYP/6-31G(d)

BDE(O-H)			
B3LYP/6-311++G(2d,2p)//PM6		B3LYP/6-311++G(2df,2p)//B3LYP/6-31G(d)	
O3-H	83.24	O3-H	81.25 (-1.99)
O4-H	81.81	O4-H	80.20 (-1.61)
O5-H	89.89	O5-H	88.26 (-1.63)

From the data on Table 3.1, it is said that the differences of the calculated BDE(O-H)s using two computed methods are insignificant and in the range of 1.63÷ 1.99 kcal/mol, but the computer time of the B3LYP/6-311++G(2d,2p)//PM6 is less than the latter one. Therefore, for further calculations, the first method is favored to apply on the larger phenolic compounds, labelled by methyl gallate, quercitrin, rutin and quercetin.

3.3.3.2.Calculated BDE(O-H) of the studied compounds: methyl gallate, quercitrin, rutin and quercetin

Table 3.2. Calculated BDE(O-H) of the studied compounds methyl gallate, quercitrin, rutin and quercetin at the B3LYP/6-311++G(2d,2p)//PM6 and calculated IE values at PM6 method

Methyl gallate		Quercitrin		Rutin		Quercetin	
BDE(O–H), kcal/mol							
O3–H	81.59	O7'–H	82.87	O7'–H	83.97	O7'–H	81.16
O4–H	81.81	O8'–H	77.20	O8'–H	79.90	O8'–H	78.73
O5–H	89.89	O11–H	90.69	O11–H	90.07	O11–H	82.26
		O12-H	100.44	O12-H	93.4	O12–H	98.15
						O13–H	89.92
IE (kcal/mol)							
192.43		172.45		171.75		178.79	
IC_{50} (µmol/ mL)							
0.011		0.005		0.012		0.006	

The lowest BDE(O–H) of compounds: methyl gallate, quercitrin, rutin and quercetin are found at the *para* position of the phenolic ring, *e.g.* at O4-H, O8'-H, O8'-H and O8'H respectively (see Figure 2). It should be noted that among three compounds: quercitrin, rutin and quercetin the BDE(O–H) values are quasi the same with very slight differences. In terms of HAT mechanism, it can be stated that three molecules: quercitrin, rutin and quercetin display the same antioxidant ability and better than methyl gallate.

3.4. Content of some compounds having antioxidant activity in seven medicinal plants

3.4.1. Preparation of sample: Same as item 2.9

3.4.2. Test quantitative methods

Carry out quantitative evaluation with the following contents: system suitability (repeatability of retention time), determination of linear range, repeatability.

3.4.2.1. Retention times

Inject 5 times of methyl gallate (0.105 mg / mL), quercetin (0.106 mg / mL) and rutin (0.107 mg / mL), quercitrin (11.760 μg / mL), α-tocopherol (1.463 μg / into the HPLC system and carry out the chromatography according to the selected conditions. Retention time of the compounds: methyl gallate, rutin, quercetin, quercitrin and α-tocopherol were respectively 15.48 ± 0.12, 33.58 ± 0.18, 55.62 ± 0.42, 15.03 ± 0.18 and 11.21 ± 0.11 minutes. The relative standard deviation (RSD) of the retention times of the compounds is less than 2%, which indicates that the chromatographic conditions are appropriate.

3.4.2. 2. Determination of linear range

Calibration was determined by preparing and evolving a series of standard solutions: methyl gallate (from 0.005 to 0.208 mg / mL), rutin

(0.005 to 0.213 mg / mL), quercetin (0.005 to 0.211 mg / mL), quercitrin (from 0.470 to 18.816 µg /mL) and α-tocopherol (0.975 to 2.925 µg / mL). Regression equations;

Methyl gallate: y = 59648698.76x + 20722.99

Quercetin: y = 48417026,11x + 10733,17

Rutin: y = 27358692,24x - 488.06 Quercitrin: y = 71262x - 3161.5

α-tocopherol: y = 1875.1x - 930.15

The correlation coefficient from 0.9992 to 1.0000 indicates the close relationship between the analyte concentration and the peak area.

3.4.2. 3. Recovery

The analytical method has a recovery rate of 92.84 to 98.54%, which satisfies the requirements of the HPLC analysis method.

3.4.3. Methyl gallate, quercetin, rutin, quercitrin and α-tocopherol contents from seven medicinal plants

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 five compounds from methanol extraction of *H. Parasitica* determined through the HPLC analysis was the highest, corresponding to the total antioxidant capacity content in the mechanism electron donor with ammonium molybdenum model in section 3.1. It was shown that the antioxidant activity by electron donor and the free radical scavenging activity of the methanol extraction *H. Parasitica* was lower than that of A. bauchei and A. bauchei at a certain concentration but total amount of five compounds in *H. Parasitica* is bigger than those.

Total amount of five compounds from methanol extraction of A. clypearia and A. bauchei were 14,939 mg/g and 4.798 mg/g, respectively. Thus, these are two very valuable medicinal herbs, not only total antioxidant capacity and the free radical scavenging activity DPPH had high activity at a certain concentration, but also contain a large amount of antioxidant capacity.

3.4.4. The correlation between antioxidant components

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 3.4. 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 3.4. 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.

CONCLUSIONS

1 Antioxidant activity of methanol extraction and fractions of seven medicine plants

1.1. Methanol extracts of seven medicine plants exhibited a good antioxidant activity obeying the hydrogen donor mechanism in the DPPH free radical scavenging with IC_{50} values from 1.20 to 17.53 μg/mL, which are strongly roughly 2 ÷ 32 times curcumin (38.50

μg/mL). Importantly, the IC_{50} values from the methanol extracts of *L. rubra* showed the highest activities, which are approximately 32 times lower than that of curcumin. Furthermore, the methanol extracts of *A. clypearia* at a low concentration (0.1 mg/mL) showed the same antioxidant ability, which is consistent with the electron donor mechanism as curcumin, but in terms of content the total antioxidant in *H. parasitica* is the highest.

1.2. The same of extraction, all fraction extracts of seven medicine plants exhibited higher antioxidant activity than curcumin in hydrogen donor mechanisms, except for the *n*-hexane fraction of *H. parasitica*, *n*-butanol fraction of *M. casearifolia* and *n*-hexane fraction of *P. venusta* showed the less activity than curcumin. Notably, all five fractions of *A. bauchei* also exhibited higher antioxidant activities than curcumin in both hydrogen and electron donor mechanisms.

1.3. Especially, the ethyl acetate fraction of *A. clypearia* showed the best antioxidant activity to DPPH free radical scavenging with the lowest IC_{50} value, which is approximately 22 times lower than that of curcumin. This fraction contains the best compounds possessing electron donor feature in the chemical *in vitro* test. Moreover, it also revealed a low ED_{50} value (0.63 μg/mL) in comparison to curcumin (4.43 μg/mL) in the *in vitro* bioassay. Additionally, it clearly showed good protection towards *in vitro* liver cells at the doses of 500 and 1000 mg/kg/day while the efficient is similar to silymarin (50 mg/kg/day) at the doses of 2000 mg/kg/day.

2. The chemical structure and antioxidant acitivity of compounds isolated from the extract of *A. bauchei* and *A. clypearia*

2.1. From aerial parts of *A. bauchei* and *A. clypearia*, the chemical structure of the sixteen compounds was identified. Eight compounds

including lup-20(29)-en-3-one, *α*-tocospiro A, *α*-spinasterol, *α*-spinasterone, daucosterol, 1-octacosanol, betulinic acid, and *α*-tocopherol were isolated from *Archidendron* for the first time in addition to the identified compounds like docosenoic, stigmasterol, oleanolic acid, methyl gallate, rutin, quercetin, quercitrin and 7-O-galloyltricetiflavan. Moreover, for the first time, A. bauchei was investigated for its chemical composition and from this species isolated ten compounds.

2.2. Among sixteen isolated compounds, six compounds showing strong antioxidant property are quercetin, methyl gallate, quercetin -3-O-α-L-rhamnopyranoside, α-tocopherol, rutin, and 7-O-galloyltricetiflavan. Both quercitrin and methyl gallate have strongly antioxidant activity in three models including DPPH free radical scavenging, antioxidant activity protect the liver *in vivo* and computational chemistry; antioxidant activity of quercetin and rutin were determined base on DPPH free radical scavenging and computational chemistry; *α*-tocopherol (vitamin E) has strongly DPPH free radical scavenging activity. At 20 µg/mL and 100 µg/mL concentration, the experimental results showed that the evaluation of the antioxidant ability based on the chemical (DPPH) and the biological model (antioxidant protection of the liver *in vitro* on rat liver) is completely compatible. These results also demonstrate that the compounds exhibit antioxidant activity *in vitro* on liver cells of rats, which agree with bond dissociation enthalpies (BDE) in computational chemistry.

3. The content and correlation between the components have antioxidant activity

The results of the total content of five compounds showed that five medicinal plants in Quang Tri province contained strong antioxidant activity with equivalent or greater content than some other medicinal plants have been published. The total phenolic content of the seven medicinal plants ranged from 16.66 to 93.22 mg GA/g while the total flavonoid content was determined between 5.62 and 71.69 mg QU/ g. Phenolic and flavonoid compounds significantly contribute to the antioxidant activity obeying the hydrogen donor mechanism. Both *A. bauchei* and *H. parasitica* contain the high amount of antioxidants, which are 3-4 times higher than that of the rest of species. The total content of five compounds is closely correlated with total phenolic compounds and total antioxidant, they significantly contribute to phenolic compounds that those the antioxidant activity. The same, methyl gallate content is strongly correlated with total phenolic compounds and total antioxidant, as it can be based on methyl gallate content to quickly evaluate the total phenolic compounds as well as the total antioxidant activity of the seven medicinal plants.

Thus, for the first time, the chemical composition, antioxidant activity- liver protection and potent antioxidant activity of the seven traditional medicinal herbs of the Pako and Bru - Van Kieu people: *Archidendron bauchei*, *Archidendron clypearia*, *Microdesmis casearifolia*, *Helixanthera parasitica*, *Pyrostegia venusta*, *Spilanthes oleracea* and *Leea rubra* are studied systematically. *Archidendron bauchei* and *Microdesmis casearifolia* have not been found literature either in Vietnam or in the world.

LIST OF PUBLISHS

1. **Le Trung Hieu**, Vo Thi Mai Huong, Nguyen Thi Hoai, Tran Thi Van Thi (2015), Study on antioxidant activities of the aerial parts and some isolated compounds from *Archidendron clypearia* (Jack) I. Niels. part 4. antioxidant capability and isolation and structural determination of some compounds from chloroform extract, *Journal of Chemistry*, Vol. 53 (6e1,2), pp. 164- 169.

2. Tran Thi Van Thi, Pham Thi Thanh Tin, Nguyen Thi Hoai **Le Trung Hieu** (2015), Study on the antioxidant activity of the fractions and the composition methyl gallate isolated from *Helixanthera parasitica* Lour., *Journal of Chemistry*, Vol. 53 (6e1,2), pp. 262- 266.

3. **Le Trung Hieu**, Vo Thi Mai Huong, Nguyen Thi Hoai, Tran Thi Van Thi (2016), Study on antioxidant activity of the aerial parts and some compounds isolated from *Archidendron clypearia* (Jack) I. Niels, Part 2. Isolating determining structure and antioxidant capability of some compounds from ethyl acetate and chloroform extract, *Journal of Science and Technology*, Vol. 54 (4), pp. 452 - 459.

4. **Le Trung Hieu**, Vo Thi Mai Huong, Nguyen Thi Hoai, Tran Thi Van Thi (2016), Antioxidant activity of the aerial parts and some compounds isolated from *Archidendron clypearia* (Jack) I. Niels, Part 1. The antioxidant activities of extracts from *Archidendron clypearia* (Jack) I. Niels, *Hue University Journal of Science*, Vol. 116 (2), pp. 27 - 33.

5. **Le Trung Hieu**, Nguyen Tran Tram Anh, Tran Thi Van Thi (2016), Determination of structure and content of some phenolic compounds isolated from Archidendron bauchei (Gagn.). I. Niels, *Journal of Science and Technology*, Vol. 54 (2B), pp. 177 - 183.

6**. Le Trung Hieu**, Le Lam Son, Tran Thi Van Thi (2017), Composition of α-tocopherol from (*Helixanthera parasitica* Lour.) *Hue University college of Sciences*, Vol. 9(1), pp. 63 - 68.

7. Le Trung Hieu, Le Lam Son, Tran Thi Van Thi (2017), Isoaltion and determine content of rutin in some selected medicinal plants, *Chemistry with sustainable development: exploitation of natural resources, food production and pharmaceuticals, Da Nang, September -2017,* pp. 230 – 234.

8. **Le Trung Hieu,** Le Lam Son, Nguyen Thi Hoai, Tran Thi Van Thi (2017), Study on antioxidant activity of the aerial parts and some compounds isolated from *Archidendron clypearia* (Jack) I. Niels, Part 3. Isolation and antioxidant activity of quercetin – 3 – O – α – L – rhamnopyranoside and 7 – O – galloytricetiflavan from *Archidendron clypearia* (Jack) I. Niels), *Chemistry with sustainable development: exploitation of natural resources, food production and pharmaceuticals, Da Nang, September -2017*, pp. 235 – 240.