International Journal of Medical Science and Health Research

Vol. 5, No. 06; 2021

ISSN: 2581-3366

The Study of Cyclic Diarylheptanoids, Flavonoids Isolation from *Betula Hippolytii*. Sukacz Leaves

Munkhbayar Narankhuu, Enkh-Amgalan Purevbat, Tuul Oidov, Altan-Erdene Narantsetseg, Ariunaa Zundui, Tserendulam Luvsandorj*

[1]Mongolian University of Pharmaceutical Sciences, Ulaanbaatar, Mongolia

*Corresponding author:
Tserendulam Luvsandorj
Mongolian University of Pharmaceutical Sciences, Ulaanbaatar, Mongolia

doi: 10.51505/ijmshr.2021.5606 URL: http://dx.doi.org/10.51505/ijmshr.2021.5606

Abstract

In Mongolia, there are 12 species of birch grow. Numerous researches conducted in Russia, Bulgaria, Japan, and China on *B.pubescens, B.pendula, B.Rezniczenkoana* (Litv) Schischk, *B.humilis* Schrank, and *B.mandshurica* Rgl Nakai found that birch barks and leaves contain antioxidants and they have anti-cancer, anti-yeast, anti-bacterial and anti-inflammatory properties, protect liver and promote bile secretion. In Mongolian traditional medicine, the birch leaves and barks are used to treat acute liver diseases. The birch leaves are considered to be not poisonous and detailed chemical compound structure of birch leaves hasn't been identified. Therefore, the purpose of this research is to conduct phytochemical research and isolate chemical compounds and their structures. The leaves of *B.Hippolytii* were powdered and extracted using 80% acetones. The fluid extracts were further evaporated and thickened. The thick-extract was suspended by ether, water and methanol 22.9 grams of diethyl ether were extracted and 12 compounds were identified using column and liquid chromatography methods and Mass spectral (MS) spectrometric methods including ^{13}C-NMR, ^{1}H-NMR, DEBT, COSY and HMBC methods. From the isolated 12 compounds, 4 compounds were cyclic diarylheptanoids and 8 compounds were flavonoids and their flavonol glycosides. The identified 4 diarylheptanoids compounds were macrocyclic diarylheptanoids: Alnusonol (4.4 mg), Alnusonon (5.6 mg), Acerogenin K (3.4 mg) and ether of diarylheptanoids 3,5'-dihydroxy-4'-methoxy-3',4"-oxo -1,7-diphenyl–1-heptene (6.5 mg). Flavonoids and their glycosides quercetin (1.6 mg), quercetin-3-O-(4-O-acetyl)-α-L-rhamnopyranoside (35.5 mg), myricetin (1.0mg), myricetin-3-O- rutinoside (1.0 mg), myricetin-3-O-(4-O-acetyl)-α-L-rhamnopyranoside (8.2 mg), keampferol-3-O-β-D-(6$^{//}$-O-E-p-coumaroyl) glucopyranoside (2.9 mg), kaempferol-3-O-α-L-rhamnopyranoside (11.9 mg) and acacetin-7-O-(4-O-acetyl)-α-L-rhamnopyranoside (9.9 mg). All compounds were isolated for the first time from this leaves *B.Hippolytii*.

Keywords: *B.Hippolytii*, 3,5'-dihydroxy-4'-methoxy-3',4''-oxo -1,7- diphenyl–1-heptene, Acerogenin K, Alnusonol, Alnusonon, flavonoids, flavonol glycosides, acacetin-7-O-(4-O-acetyl)-α-L-rhamnopyranoside

Vol. 5, No. 06; 2021

ISSN: 2581-3366

Background

Diarylheptanoids naturally occurring and abundant in various bushes and trees. Diarylheptanoids (C_6-C_7-C_6) of two aromatic rings linked by a linear seven carbon aliphatic chain C7 and basic chemical name is a 1,7-diphenyl-heptane and the structures had open chain linear or cyclic compounds [**Error! Reference source not found.**]. The structures had open chain linear or cyclic compounds, diarylheptanoids are typical secondary metabolites in the genus Betula and widely distributed in other genera, such as Zingiber, Curcuma, Alpina and Alnus [Cho.N., et al, 2016].

All the cyclic diarylheptanoids of the biphenyl and biphenyl ether- types (isolated from Acer and Myrica), and of the acyclic-type diarylheptanoids (isolated from Curcuma, Zingiber, Centrolobium, Alnus, and Betula species) have the carbonyl group at C_3. Nomura and others confirmed recently the co-occurrence of the cyclic diarylheptanoids [Terazawa. M,et al.,1984].

In addition more complex diarylheptanoids with the basic skeleton extended by fragments such as aryl butyl, chalcone or flavonoid moieties have been isolated. Diarylheptanoids have been isolated from various genera such as Acer (Aceraceae), Platycaria (Juglandaceae), Myrica (Myricareceae), Centrolobium (Leguminosae), Alpina, Curcuma, and Zingiber (Zingiberaceae) and Alnus and Betula (Betulaceae) [Ibrahim. S.R.M., et al., 2016].

Flavonoids are secondary metabolites of plants and have 15-carbon skeleton structures containing two phenyl rings and heterocyclic ring. More than 5000 naturally occurring flavonoids have been reported in various plants [**Error! Reference source not found.**].

The birch family various genus distributed in the Southern hemisphere in Europe, East and Northern America and Asia. The birch family- Betulaceae C.F.Gray is comprised of 6 plant species: Alnus, Betula, Carpinus, Corylus, Ostrayand Ostryposis and most commonly distributed in the northern hemisphere [Rastogi S., et al., 2015]. The birches are tolerant in cold temperature and mostly grow in the highland, mountainous zone with height 600-1200 meters above from oceans level [**Error! Reference source not found.**].

Numerous researches conducted in Russia, Bulgaria, Japan, and China on *B.pubescens, B.pendula, B.Rezniczenkoana, B.humilis, B.mandshurica* found that birch barks and leaves contain antioxidants and they have anti-cancer, anti-yeast, anti-bacterial and anti-inflammatory properties, protect liver and promote bile secretion (Al-Snafi. A. E., et al, 2015).

The birch can with stand extreme climate of Mongolia and grow in northern part of the country. In Mongolia, there are 12 species of birch family [Gruvob V L., 2008] grow. *B.Hippolytii, B.platyphylla, B.mandshurica, B.microphylla, B.Rezniczenkoana, and B.humilis.* Schrank [**Error! Reference source not found.**] are noted to be used as medicine. *B.Hippolytii* [Shagdarsuren M., 2007] grow in forests and step-forest zones, and high-mountain zones of Khentii, Khangai and Mongolian Daguur [Gruvob V L., 2008].

Vol. 5, No. 06; 2021

ISSN: 2581-3366

In Mongolia, a few studies have been done to identify the compounds of birch barks, and parasitic fungi growing on birch bark called chaga. The study used weight method and found that the flat leaved birch (*B.platyphilla*) bark contained 25.12% of betulin and 5.08% of lupeol [**Error! Reference source not found.**]. The birch leaves contained 2.9%, of flavonoid, 0.6% of ascorbic acid and along with resin, astringent, spirit triterpenes, tannins, saponin and carotene [**Error! Reference source not found.**]. Mongolian birch leaves phytochemistry and pharmacology, traditional usage, chemical compounds and biological activities are not studied well.

Therefore, the study aimed to explore chemical compounds and biological activities of *B.Hippolytii* birch tree. Specifically, its leaves and barks are commonly used as herbs in Mongolian traditional medicine and haven't been studied well. The birch leaves are thin, egg like shaped with heart shaped bottom with 35-70 cm length. Hence, such study has great scientific significance to the development of herbal medicine.

Materials and methods: The pure substances of *B.hippolytii's* leaves were extracted using HPLC, NMR, HH-COSY, HMQC, HMBC and MS methods.

Study results: *B.hippolytii*'s leaves were extracted using 1:10 proportionate 80% acetone to get thick-extract which was suspended by ether, water and methanol. Afterwards, the extract was fractionated. Furthermore, the ether and water fractions were used to obtain the molecule structures of pure diarylheptanoid's4 compounds and 8 flavonoid glycosides.
The molecular structure of compound's 4 obtained and established from birch leaves *B.Hippolytii*. 3,5'-dihydro-4'-methoxy-3,4''-oxy-1.7-diphenyl-1-heptene

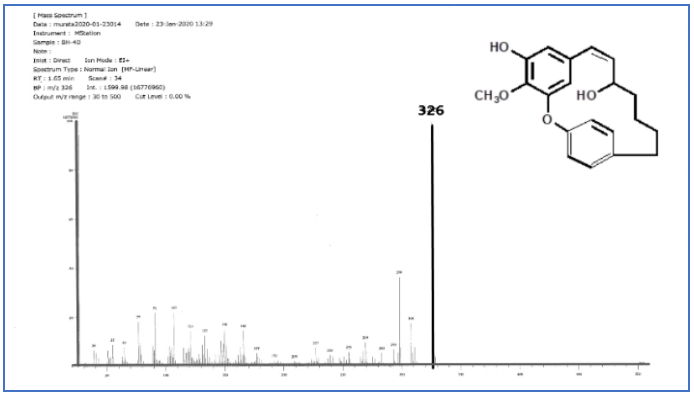


Figure 1. Mass spectra of compounds 4

Compound 4 molecular mass established as $C_{20}H_{22}O_4$ from the HRESIMS quasi-molecular ion peak at m/z 326 [M+H]. The IR, UV, spectral data, ^{1}H and ^{13}C-NMR spectroscopic analyses of molecular formula compound 4 were established as $C_{20}H_{22}O_4$. (**Figure** 1). 3,5/ dihydroxi-4/

methoxy 3', 4''-oxi-1.7-diphenyl-1-heptene is good solved in nonpolar solven tchloroform, colorless white, amorphous powder.

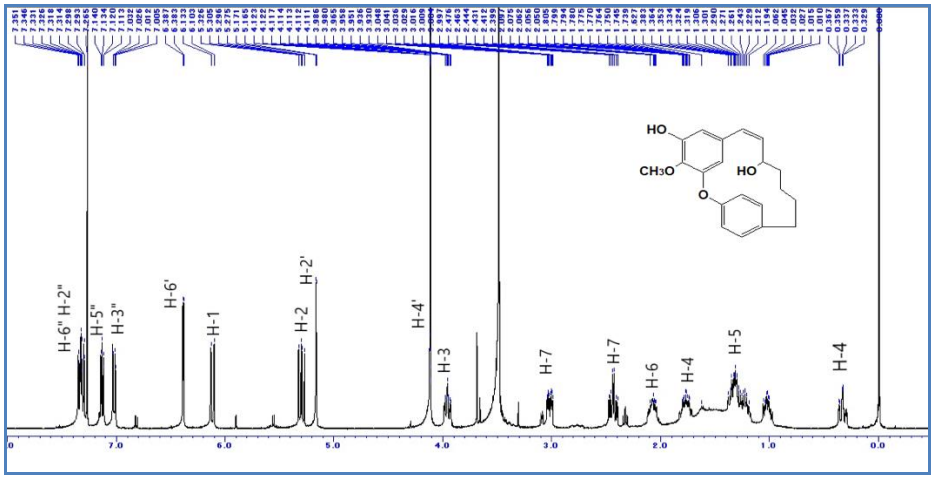


Figure 2. ^{1}H–NMR spectra ($CDCl_3$ -d_3) of the compound 4

The ^{1}H-NMR spectrum showed the presence of a 3, 4$^{/}$, 5$^{/}$ -trisubstituted phenyl group compound 6.39 (1H, d, *J*=1.6 Hz), 5.17 (1H, d, *J*=2.0 Hz), a 4 substituted phenyl group which is restricted free rotation 7.34 (1H, overlapped), 7.32 (1H, m), 7.13 (1H, dd, *J*=8, 2 Hz), an aromatic methoxy group 4.12 [3H, s)], a *cis*-substituted double bond 6.12 (1H, d, *J*=12.0 Hz), 5.30 (1H, dd, *J*=12, 8 Hz), and secondary hydroxy group [3.96 (1H, *ddd*,*J*=11.2, 8.8, 2.4 Hz)]. By the ^{1}H-^{1}H and long - range ^{1}H-^{13}C-COSY and the nuclear Overhauser effect correlation spectroscopy (NOESY), the structure of 4 was determined as 3,5'-dihydro-4'-methoxy-3',4''-oxo-1.7-diphenyl-1-heptene (**Figure** 2).In addition, ^{1}H-^{1}H COSY, ^{13}C-NMR, HMQC, and HMBC spectra were recorded.

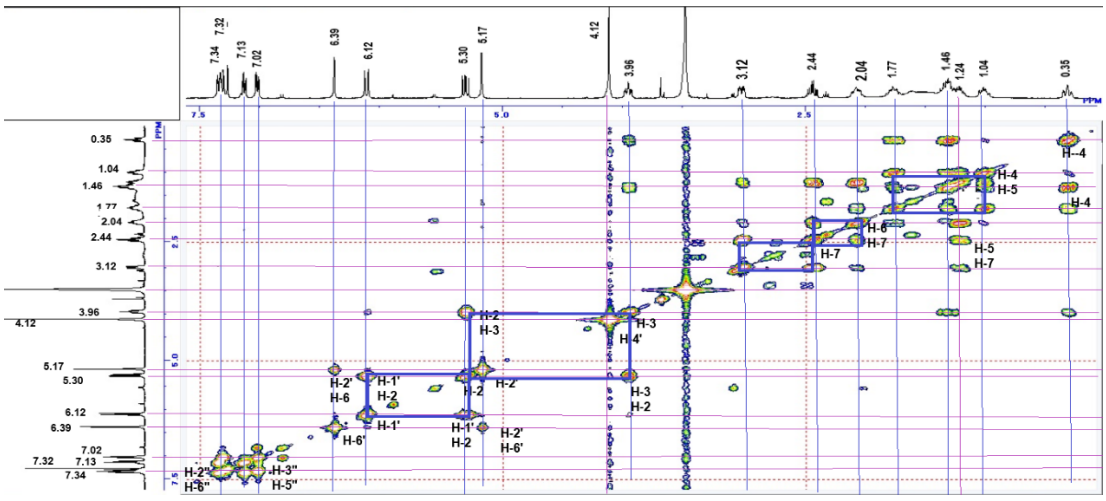


Figure3. ^{1}H-^{1}H-COSY spectra of the compound 4 (MeOH-d4)

Vol. 5, No. 06; 2021

ISSN: 2581-3366

The ^{1}H-^{1}H protons between correlation and bond sequences established by the^{1}H-^{1}H-COSY data spectra. The^{1}H-^{1}H-COSY specter's cross peaks of proton signals showed atfigure 3.

^{1}H-^{1}H-COSY specter's proton signal appeared at 6.39 (H-3') cross peaks with at 5.17 (H-2'), proton signal at 6.12 (H-1) cross peaks with at 5.30 (H-2), and proton signal at 5.30 (H-2) cross peaks with at 6.12 (H-1) and proton signal appeared at3,96 (H-3)cross peak with proton at 5.30 (H-2) and at 1.46, 0.35 (H-4), proton signal appeared at 1.77, 1.04(H-5) cross peaks with at 1.46, 0.35 (H-4), and 2.07, 1.24 (H-6), proton signal appeared at2.07, 1.24 (H-6) cross peaks with 1.77, 1.04 (H-5) and with3.02, 2.44 (H-7), proton signal appeared at7.13, 7.02 (H-3") cross peaks with 7.34 and 7.32 (H-2")(**Figure** 3).

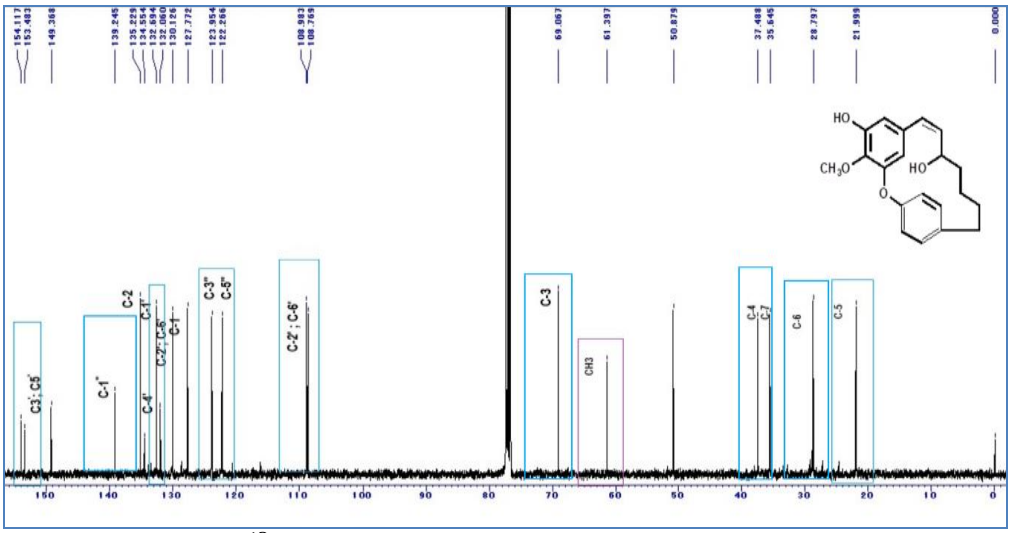


Figure 4. ^{13}C-NMR spectra (CHCl3-d4) of the compound-4

The ^{13}C-NMR spectrum showed the presence first aromatic cycle were dismissed on the carbons 3,4',5'positions. An aromatic methoxy (–OCH_3) group was situated at signal 61.4 carbon C-4', aromatic hydroxyl group (-OH) was situated at carbon C-5', the two carbons were of first aryl cycle C-2" and C-6" specters signal at 130.1 and at 132.7, also obtain founded secondary aryl cycle were established in carbon C-2", C- 6" specters signals appeared at130.1 and at 132.7 and carbons C-3", C-5" specters signals appeared at124.0; 122.3;

In addition, the seven carbon chain of heptane (C7) double bond appeared carbon spectra signal at127.8-135.3 between carbons from C-1; to C-2 the *cis*-position and second hydroxyl group suggested at 69.1 position C-3. These result suggested that was founded a cycle compound of diphenyl-type-1,7-heptene-1.

Table 1.^{1}H, ^{13}C- NMR data spectra of compound 4

Position	δ_H *(J in Hz)*	δ_C	*HMBC*

1	6.12 (*d*, 12.0)	127.8	3. 1′. 2′.6′
2	5.30 *dd*(J=12.0, 8.0 Hz)	135.2	1′
3	3.96 *dd*(J=11.2, 8.8, 2.4 Hz)	69.1	
4	1.46	37.5	3
5	1.44; 1.04 *m*	22.0	6.
6	2.04; 1.24 m	28.8	4
7	2.43; 3.02 *ddd*	37.5	6. 1′. 2′
1′	-	132.1	-
2′	5.1 *d* (J=2.0 Hz)	109.0	2. 3′. 4′
3′	-	153.5	
4′	-	134.5	
5′	-	149.3	4′. 6′
6′	6.39 d (J=1.6 Hz)	108.8	2′. 4′. 5′
1″	-	139.2	4″
2″, 6″	7.34 *m*	130.1	
3″, 5″	7.13 *dd*(J= 2.8 Hz)	124.0	1″
4″	-	154.1	
C-4′ CH_3O	4.12	50.9	4′
C-5′ OH		-	4′. 5′. 6′

3,5’-dihydroxy-4’methoxy-3’,4’’-oxo -1,7-diphenyl-1-heptene

The ^{13}C-NMR spectrum of compound 4 showed the presence 12 carbonsspecters signals in interval at 50.9-154.2, and obtained two aromatic cycle carbons specters signals at 108.8-153.5 and at 124.0-154.1. Also, methoxy group’s specter signal appeared at 50.9; The H-NMR spectrum of compound 4 showed the presence 8 protons signals. Also recorded the HMQC spectrum of substance 4 to determine direct link connection with what carbons of the 8 protons.

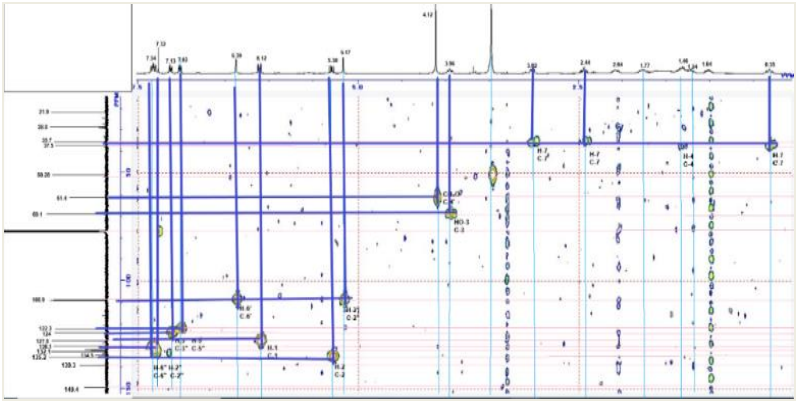


Figure 5. HMQC spectra compound’s 4 (MeOH-d_4)

Vol. 5, No. 06; 2021

ISSN: 2581-3366

By the HMQC spectrum obtain determined the carbons connection with hydrogen protons (Figure 5). The HMQC spectrum explanation approved conformity with 1H and 13C NMR specters of compound 4.From HMQC spectrum the specters signals correlation appeared the signal at δC 127.8 (C-1) was correlated with at δH 6.12 (d; 12.0; H-1), the signal at δC 135.2 (C-2) was correlated with at δH 5.30 (*dd*; 12.0, 8.0; H-2), the signal at δC 69.1 (C-3) was correlated with at δ_H 3.96 (*ddd*;11.2, 8.8, 2.4; H-3), the signal at δ_C 124.8 (C-3) was correlated with δ_H 7.38 (d;3.8; H-3), the δC 37.5 (C-4)was correlated with δ_H 1.46, 0.35 (*m*, H-4), the δC 22.0 (C-5) was correlated with δ_H 1.44, 1.04 (*m*, H-5), the δC 28.8 (C-6) was correlated with δ_H 2.04, 1.24 (*m*, H-6), the δ_C 35.7 (C-7) was correlated with δ_H 3.02, 2.44 (*ddd*, H-7), the δ_C 109.0 (C-2') with H-2' δ_H 5.17 (*d*;2.0), the δ*C* 134.5 (C-4') was correlated with δ_H 4.12 (*s*, H-4'), the δ_C 108.8 (C-6') was correlated with δ_H 6.39 (*d*;1, 6; H-6'), the signal at δ_C 132.7 (C-2")and 130.1 (C-6") were correlated with δ_H 7.34 (*m*, H-2"), 7.32 (*m*, H-6"), the signal at δ_C 124.0 (C-3") and 122.3 (C-5")were correlated with δ_H 7.13 (*dd*, 8.0, 2.0, H-3") and 7.01 (*dd*, 8.0, 2.0; H-5").

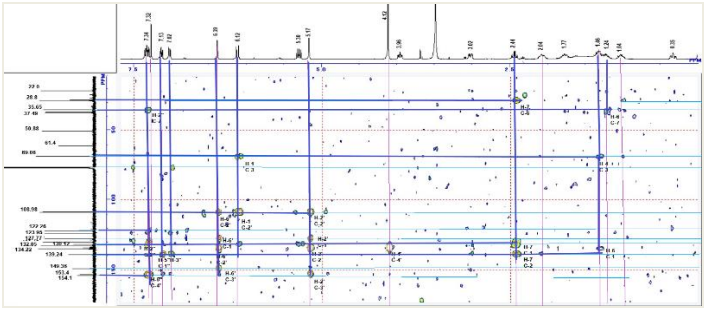


Figure 6. HMBC spectra compound's 4 (methanol-d_4)

The HMBC spectrum have established the methoxy group's proton specters signal appeared at 4.12 and was connected with carbons signal at 134.5 of the aromatic rings

(Figure 6). The phenyl group's the specter signal appeared at 6.39 (H-6') proton's and connected with carbons at 127.5; 109.0; 134.0. The second phenyl group's proton at the position H-3" the proton specters signals appeared at 7.13, and 7.02 and detected cross peaks with carbon's atom at 139.3, It showed, and have contained 2 phenyl groups.

In *cis*-position appeared double bond specters signal detected at 6.12 in position H-1 proton were cross peak with carbons at 69.1, 132.1, 109.0 specters signals in position C-3, C-1', C-2' carbons, the proton specter signal detected at 1.46 and 0.35, in positions H-4, and the proton were cross peaks with carbon signals at 69.1, 135.2 inpositions C-3 and C-2 of carbons, also protons specters signals appeared at 2.44 and 3.02 in position H-7 proton detected cross peaks with carbons signals at 28.8, 139.3, 132 in positions C-6, C-1", C-2" carbons. That's were confirmed the heptane have connecting with two phenyl rings. Was used intersecting intersection of peaks and made assigned all carbon atoms of compound's 4

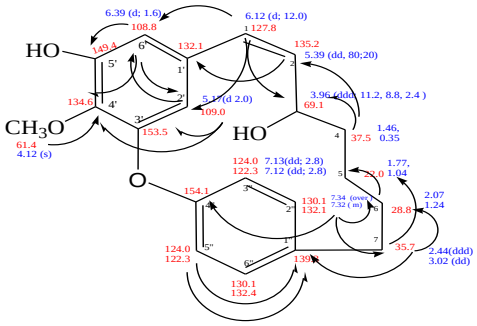


Figure 7. HMBC spectra compound's 4 (methanol-d_4**)**

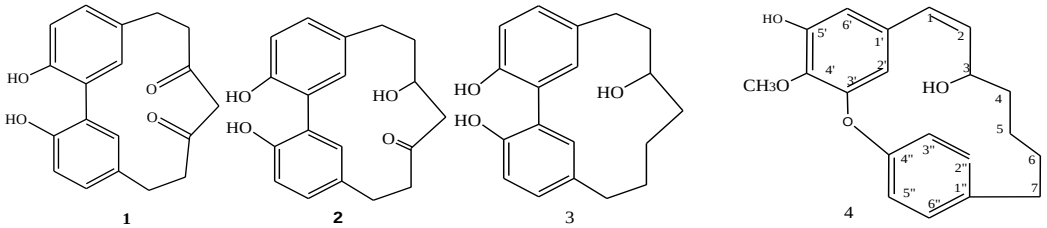


Figure 8. Chemical structures isolated compounds 1,2,3, 4

Compound 1. Molecular formula of compound 1 established by analyze spectra HR-FAB-MS analyses. and ^{1}H and ^{13}C-NMR specter signals analyses. (**Figure 2.**), ^{1}H, ^{13}C NMR specter signals showed (Table 2). Colorless crystal powder. HR-FAB-MS; m/z 311.12 [M+H]+ (311.12, $C_{19}H_{19}O_4$). Alnusonon (4.4 мг) [Fuchino. H., et al., 1996].

^{1}H-^{13}C-NMR: showed (**Table 2**). MS: m/z (%): 311 (21), 310 (M+, 100), 226 (66), 252 (14), 225 (27), 212 (15), 211 (75), 210 (39), 165 (14), 85 (46). ^{1}H-NMR (CDCl3) δ (ppm): 2.5 (2H, m, H-12), 2.5 (2H, m, H-8, 3.37 (2H, m, H-13), 2.8 (2H, m, H-7), 5.92 (1H, d, J = 15.2, H-10), 6.8/7.9 (1H x 2, d, J = 8.6, H-4, H-16), 7.13 (1H x 2, d J = 2.4, H-18, H-19), 7.02 (2H x 2, m, H-5, H-15). ^{13}C-NMR (CDCl3) δ (ppm): 29.6 (C-7, CH2), 32.9 (C-13, CH2), 35.02 (C-12, CH2), 39.8 (C-8, CH2), 116.7/116.3 (C-4, C-16, CH), 125.9 (C-1, C-2, C), 128.9 (C-5, C-15, CH), 132.8 (C-6, C-14, C), 107.1 (C-10, CH), 133.6 (C-18, C-19, CH), 149.6 (C-11, C=O), 150.6 (C-3, C-17, C), 201.9 (C-9, OH).

The ^{1}H-NMR spectrum of compound 1 indicated olifenic signals at 6.8 (1H, d, *J*=1.6 Hz)and 3,17-dihidroxy-biphenyl (C_6H_5-OH) groups, in diphenyl rings determined at positions 9, 11 dismissed hydroxyl and keto groups. ^{13}C-NMR spectrum obtained 19 carbons specter signal and atoms signals were detected in intervals at 27.6-135.1 and at 35.8-130.0. Also detected two keto groups signal at 68.0 (C9; C11).In H-NMR spectrum registered 12 protons specters signal and were determined direct connection with carbons atoms.

Compound 2. Colorless crystal powder. HR-FAB-MS; m/z 312.12 [M+H]+ (335.12, $C_{19}H_{20}NaO_4$). ^{1}H-^{13}C-NMR: **Table 2** MS: m/z (%): 311 (21), 310 (M+, 100), 226 (66), 252 (14), 225 (27), 212 (15), 211 (75), 210 (39), 165 (14), 85 (46). **^{1}H-NMR** (CDCl3) δ (ppm): 2.31 (2H, m, H-12), 2.73 (2H, m, H-8), 2.73 (2H, m, H-13), 3.0 (2H, m, H-7), 2.87 (1H, d, J = 15.2, H-10), 6.67/6.68 (1H x 2, d, J = 8.6, H-4, H-16), 6.66/6.47 (1H x 2, d J = 2.4, H-18, H-19), 7.02/6.92 (2H x 2, m, H-5, H-15). **^{13}C-NMR** (CDCl3) δ (ppm): 29.3 (C-7, CH2), 29.1 (C-13, CH2), 35.7 (C-12, CH2), 38 (C-8, CH2), 117.1/117.0 (C-4, C-16, CH), 127.1 (C-1, C-2, C), 134.6 (C-5, C-15, CH), 132.3 (C-6, C-14, C), 54.1 (C-10, CH), 129.6 (C-18, C-19, CH), 67.4 (C-11, C=O), 152.3 (C-3, C-17), 212.2 (C-9). MS: m/z (%): 295 (9), 294 (M+, 42), 226 (7), 225 (14), 212 (25), 211 (100), 210 (11), 165 (9)**Error! Reference source not found.**

The molecular formula of compound 2 was by HR-ESI-MS ^{1}H-NMR and ^{13}C-NMR spectrum analysis determined. HR-FAB-MS; m/z 312.12 g/mol [M+H]+ 312.12, molecular formula $C_{19}H_{20}O_4$.Named Alnusonol (5.6мг)Colorless crystal powder. Mp 171-173^0, had IR absorption bands at 3410, 3120 (OH) [Fuchino. H., et al., 1996].

The ^{1}H-NMR spectrum of compound 2 in position detected 3, 17-dihidroxy (-OH) groups, diphenyl rings signals appeared at 6.8 (1H, d, J=1.6 Hz) and hydroxyl and keto groups were detected in positions 9,11.^{13}C-NMR spectrum obtained 19 carbons atoms signals were detected between intervals at 29.3.1-152.3. In the specters signals obtain detected two aromatic rings between intervals at 117.1-152.3. Also two hydroxyl groups of the aromatic rings were detected in specters signals at 116.9 and at 152.7. In the aliphatic chain of heptane were detected hydroxyl or keto groups specters signal at 201.9 (C9; C11). In H-NMR spectrum registered 12 protons and were determined direct connection with carbons atoms presented by table 3.

Compound 3. Colorless crystal powder. HR-FAB-MS; m/z 312.12 [M+H]+ (335.12, $C_{19}H_{22}NaO_3$). ^{1}H-^{13}C-NMR: Хүснэгт 7. MS: m/z (%): 311 (21), 310 (M+, 100), 226 (66), 252 (14), 225 (27), 212 (15), 211 (75), 210 (39), 165 (14), 85 (46).
^{1}H-NMR (CDCl3) δ (*ppm*): 3.4 (2H, m, H-12), 2.49 (2H, m, H-8), 3.5 (2H, m, H-13), 2.77 (2H, m, H-7), 1.29 (1H, d, J = 15.2, H-10), 6.8 (1H x 2, d, J = 8.6, H-4, H-16),7.26 (1H x 2, d J = 2.4, H-18, H-19), 7.02/6.92 (2H x 2, *dd*, H-5, H-15). ^{13}C-NMR (CDCl3) δ (ppm): 27.6 (C-7, CH2), 30.3 (C-13, CH2), 27.1 (C-12, CH2), 35.8 (C-8, CH2), 116.9,116.3 (C-4, C-16, CH), 127.1 (C-1, C-2, C), 130.0 (C-5, C-15, CH), 131.6 (C-6, C-14, C), 40.7 (C-10, CH), 135.1 (C-18, C-19, CH),193.8 (C-11, CH2), 152.3 (C-3, C-17, C), 68.0 (C-9, OH). Molecular formula of compound 3 were established by spectroscopic analysis MS and ^{1}H and ^{13}C-NMR method (*m/z*298 [M]). Molecular formula $C_{19}H_{22}O_3$. Named Acerogenin K (3.4 mg). Colorless crystal powder [Ogura T., et al, 2013].

The ^{1}H-NMR spectrum of compound 3 in position detected 3,17-dihidroxy (-OH) groups, diphenyl rings signals appeared at 6.8 (1H, d, J=1.6 Hz) and hydroxyl group was detected in position 9.

^{13}C-NMR spectrum obtained 19 carbons atoms signals were detected between intervals at 27.6-152.7. In the specters signals registered two aromatic rings between intervals at 116.9-152.7. Also two aromatic rings hydroxyl groups specters signals were detected at 116.9 and at 152.7.

In the aliphatic chain of heptane was detected hydroxyl group's specters signal at 68.0 (C9).

In ^{1}H-NMR spectrum registered 12 protons and were determined direct connection with carbons atoms presented by table 3.

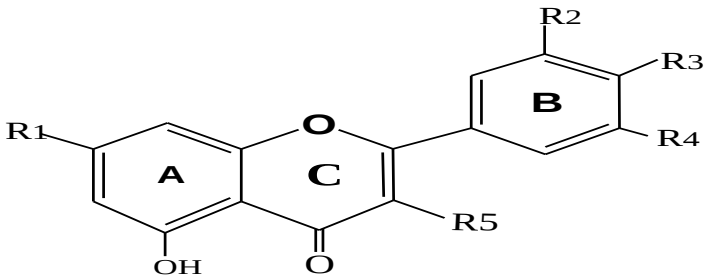
	1			*2*			*3*		
Байрлал	δ_H *(J in Hz)*	δ_C	*HMBC*	δ_H *(J in Hz)*	δ_C	*HMBC*	δ_H *(J in Hz)*	δ_C	*HMBC*
1; 2	-	127.4		-	125.9		-	127.1	
3; 17	-	152.7		-	150.6		2.87	152.3	
4; 16	6.8 (d)	116.9		6.8 d (7.9)	116.7		6.67 (*d*)	117.1	
5; 15	7.02 (*dd*)	130.0;	*C7; C13*	7.02 (*dd*)	128.9.	*C7; C13*	7.02 (*dd*)	134.6	*C7; C13*
6; 14	-	131.6		-	132.8		-	132.3	
7; 13	2.77 (*m*)	27.6	*C18; C19*	2.8 *(m)*	29.6	*C18; C19*	3.0 (*m*)	29.3	*C18; C19*
8; 12	2.49 (*m*)	35.8	*C9; C10*	2.5(*m*)	39.8	*C9; C10*	2. 73 (*m*)	38	*C9; C10*
9 OH; 11	1.5-1.36	68.0		-	201.9		-	212.2	
10	1.29	40.7	*C8; C9; C11; C12*	5.92 (*s*)	107.1	*C8; C9; C11; C12*	2.87	54.1	*C8; C9; C11; C12*
18;19	7.26	135.1	*C7; C13*	7.13 d *(2.0)*	133.6	*C7; C13*	6.66	129.6	*C7; C13*

Table 2.^{1}H and ^{13}C-NMR data for compounds 1, 2, 3

2. Aqueous extract separated compounds by HPLC method Preparative HPLC was performed applying a JASCO 2089 with UV detection at 210 nm, using the following columns: TSK gel ODS-120T, Ultra Pack ODS-MS-50C-M, Develosil C30-UG-5, Capsell Pak C8, Mightysil RP18. In this study eighth known compounds of flavonoid and flavonoid glycosides were isolated from B.Hippolytii birch leaves. From methanol fraction *B.Hippolytii* leaves obtained

compounds 6-12 were flavonoids with 1 and 2 sugar unit and sugars with acetyl and coumaric acid.

Table4. The structure of compounds 5-12



Compound	R1	R2	R3	R4	R5
5	OH	OH	OH	H	OH
6	OH	OH	OH	H	O-(4$^{//}$-O-acetyl) – rhamnopyranoside
7	OH	OH	OH	OH	OH
8	OH	OH	OH	OH	O- rutinoside
9	OH	OH	OH	OH	O-(4$^{//}$-O-acetyl) – rhamnopyranoside
10	OH	H	OH	H	O-(5$^{//}$-O-coumaric acid) – glucopyranoside
11	OH	H	OH	H	O-rhamnopyranoside
12	O-(4$^{//}$-O-acetyl) – rhamnopyranoside	H	OCH3	H	H

Compound 5. Yellow needles (MeOH); mp 279-281 °C; UV λ max nm (MeOH): 210, 254, 370; IR (KBr) ν max cm^{-1}: 3400 (OH), 1643, 1590; ^{1}H-NMR (MeOH-d$_4$): δ 3.34 (1H, *m, H-5*), 6.18 (1H, d, J = 2.0 Hz, H-6), 6.39 (1H, d, J = 2.0 Hz, H-8), 7.65 (1H, *d, J*=2.0 Hz, H-2$^{/}$), 3.35 (1H, m, H-3$^{/}$), 3.37(1H, m, H-4$^{/}$), 3.30 *(1H,s, H-4$^{/}$)*, 6.88 (1H, *dd, J*=8.4 Hz, H-5$^{/}$), 7.36 (1H, *dd, J*=8.4 Hz, H-6$^{/}$); ^{13}C–NMR (MeOH): 146.9(C-2), 135.5(C-3), 175.8 (C-4), 160.7 (C-5), 98.2 (C-6), 163.9 (C-7), 93.3 (C-8),156.2 (C-9), 103.1(C-10), 122.1(C-1$^{/}$), 115.3(C-2$^{/}$), 145.0 (C-3$^{/}$), 147.6 (C-4$^{/}$), 115.6 (C-5$^{/}$), 121.6 (C-6$^{/}$); EIMS m/z (rel. int.): 302 (100[M]$^{+}$), 301(31), 273 (10), 229 (10), 228(9), 153 (18), 137 (28)128 (19), 69 (35); Calcd for $C_{15}H_{10}O_7$.Named quercetin [Kim. S.Y., et al.,1999].

Compound 6. A yellow crystalline powder, mp 171-176^{0}C, $[\alpha]_D$ -158^0 (c=1.0 MeOH) 1H-NMR 6.18 (1H, *d*,*J*=2.0 Hz, H-6), 6.56 (1H, *d*,*J*=2.0 Hz, H-8), 7.30 (1H, *d*, *J*= 2.0 Hz, H-2$^{/}$), 6.22 (1H, *d*, *J*=2.0 Hz, H-3$^{/}$), 6.40 (1H,*dd*, *J*=9.9, 1.0 Hz, H-4$^{/}$), 6.9 (1H, *d*, *J*=8.3 Hz, H-5$^{/}$), 7.24 (1H, *d*,*J*=8.3, 2.0 Hz, H-6$^{/}$), 4.72 (1H, *d*, *J*=1.7 Hz, H-1$^{//}$), 5.24 (1H,*d*,*J*=1.0 Hz, H-2$^{//}$), 2.01 (1H, *s*, H-3$^{//}$), 3.4 (1H, *dq*, *J*=9.9, 6.3 Hz,H-4$^{//}$), 3.75 (1H,*dq*, *J*=9.9, 3.3 Hz, H-5$^{//}$) 4.04 (1H,*dd*, *J*=3.0, 1.0 Hz, H-6$^{//}$), 0.94 (3H, *d*, *J* = 6.3 Hz, CH_3); ^{13}C-NMR 156.5 (C-2), 134.0 (C-3), 177.6 (C-4), 161.3 (C-5), 98.9 (C-6), 164.6 (C-7), 93.7 (C-8),157.5 (C-9), 104.0 (C-10), 121.0 (C-1$^{/}$), 115.5 (C-2$^{/}$), 145.3 (C-3$^{/}$), 148.6 (C-4$^{/}$), 115.8 (C-5$^{/}$), 120.6 (C-6$^{/}$), 101.5 (C-1$^{//}$), 70.0 (C-2$^{//}$), 67.9 (C-3$^{//}$), 73.2 (C-4$^{//}$), 67.9 (C-5$^{//}$), 17.1 (C-6$^{//}$), 170 and 20.9 (Ac); HR-FAB-MS (negative mode) *m/z* 489.105[M-N]$^-$, Calcd for $C_{23}H_{21}O_{12}$; Namedquercetin 3-O-(4-O-acetyl)-α-L–rhamnopyranoside [Fuchino. H., et al., 1996]

Compound 7. Yellow needles (MeOH); ^{1}H-NMR (MeOH-d_4): δ 3.29 (1H, *m*, *H-3*), 3.30 (1H, *m*, *H-5*), 6.16 (1H, d, J = 2.0 Hz, H-6), 6.37 (1H, d, J = 2.0 Hz, H-8), 6.36 (1H, *d*, *J*=2.0 Hz, H-2$^{/}$), 3.29 (1H, m, H-3$^{/}$), 3.30 (1H, m, H-4$^{/}$), 3.29 *(1H,s, H-5$^{/}$)*, 6.36 (1H, *dd*, *J*=8.4 Hz, H-6$^{/}$);^{13}C–NMR (MeOH): 159.8 (C-2), 135.5(C-3), 175.5 (C-4), 166.0 (C-5), 99.4 (C-6), 163.2 (C-7), 94.8 (C-8),158.6 (C-9), 105.9 (C-10), 121.8(C-1$^{/}$), 99.8(C-2$^{/}$), 147.0 (C-3$^{/}$), 137.8 (C-4$^{/}$), 147.0 (C-5$^{/}$), 99.8 (C-6$^{/}$); EIMS m/z 318.23g/mol, Calcd for $C_{15}H_{10}O8$; Named myricetin [Kozhamkulova. Z. A., et al., 2010]

Compound 8. Yellow needles (MeOH); ^{1}H- NMR (MeOH-d_4): δ 3.30 (1H, *m*, *H-5*), 6.21 (1H, d, J=2.1 Hz, *H-6*), 6.37 (1H, d, J = 2.1 Hz, H-8), 6.9 (2H, *s*, *H-2'*), 3.36 (1H, *dd*,*J*=9.8; 6.2, Hz, H-3$^{/}$), 4.82 (1H, *t*, *J*=9.8; 6.2, Hz, H-4$^{/}$), 3.36 (1H, *dd*,*J*=9.8; 6.2, Hz, *H-5$^{/}$)*, 6.9 (2H, s,, H-6$^{/}$); 4.62 (1H, *d*,*J=7.5* Hz, H-1$^{//}$), 3.25 (1H, *d*, *J*=3.4; 1.6 Hz, H-2$^{//}$), 3.45 (1H, *dd*,*J*=9.8; 6.2, Hz, H-3$^{//}$), 3.18 (1H, t, J=9.0 Hz, H-4$^{//}$), 3.45 (1H, m, H-5$^{//}$), 3.40 (1H, *dd*,*J*=11.5, 5.0 Hz, H-6$^{//}$),4.54 (br, s, H-1$^{///}$), 3.66 (1H, *dd*, *J*=4.0, 1.5 Hz, H-2$^{///}$), 3.44 (1H, m, H-3$^{///}$), 3.15 (1H, *t*, *J*=9.5 Hz, H-4$^{///}$), 1.06 (3H, *d*, *J*=6.5 Hz, H-6$^{///}$); ^{13}C – NMR (MeOH): 159.8 (C-2), 135.5(C-3), 175.5 (C-4), 166.0 (C-5), 99.4 (C-6), 163.2 (C-7), 94.8 (C-8),158.6 (C-9), 105.9 (C-10), 121.8(C-1$^{/}$), 99.8(C-2$^{/}$), 147.0 (C-3$^{/}$), 137.8 (C-4$^{/}$), 147.0 (C-5$^{/}$), 99.8 (C-6$^{/}$);102.4 (C-1$^{//}$), 83.1 (C-2$^{//}$), 76.1 (C-3$^{//}$), 69.2 (C-4$^{//}$), 76.5 (C-5$^{//}$), 60.3 (C-6$^{//}$), 100.5 (C-1$^{///}$), 70.4 (C-2$^{///}$),70.8 (C-3$^{///}$), 72.1 (C-4$^{///}$), 68.4 (C-5$^{///}$), 17.8 (C-6$^{///}$); EIMS m/z 626.52g/mol, Calcd for $C_{27}H_{30}O17$;Named myricetin-3-O-rutinoside [Xiong. J., et al.,2016].

Compound 9.Yellow needles (MeOH); ^{1}H- NMR (MeOH-d_4): δ 6.21 (1H, d, J=2.1 Hz, *H-6*), 6.37 (1H, d, J = 2.1 Hz, H-8), 6.9 (2H, *s*, *H-2'*), 3.36 (1H, *dd*,*J*=9.8; 6.2, Hz, H-3$^{/}$), 4.82 (1H, *t*, *J*=9.8; 6.2, Hz, H-4$^{/}$), 3.36 (1H, *dd*,*J*=9.8; 6.2, Hz, *H-5$^{/}$)*, 6.9 (2H, s,, H-6$^{/}$); 5.46 (1H, *d*,*J*=1.6 Hz, H-1$^{//}$), 4.21 (1H, *d*, *J*=3.4; 1.6 Hz, H-2$^{//}$), 3.92 (1H, *dd*,*J*=9.8; 6.2, Hz, H-3$^{//}$), 0.80 (3H, *d*,*J*=6.2 Hz, H-6$^{//}$), 0.812 (3H, *d*,*J*=6.2 Hz, H-8$^{//}$); ^{13}C – NMR (MeOH): 159.8 (C-2), 135.5(C-3), 175.5 (C-4), 166.0 (C-5), 99.4 (C-6), 163.2 (C-7), 94.8 (C-8),158.6 (C-9), 105.9 (C-10), 121.8(C-1$^{/}$), 99.8(C-2$^{/}$), 147.0 (C-3$^{/}$), 137.8 (C-4$^{/}$), 147.0 (C-5$^{/}$), 99.8 (C-6$^{/}$);103.4 (C-1$^{//}$), 71.6 (C-2$^{//}$), 72.2 (C-3$^{//}$), 75.1 (C-4$^{//}$), 69.6 (C-5$^{//}$), 17.7 (C-6$^{//}$), 172.7 (C-7$^{//}$), 21.0 (C-8$^{//}$); EIMS m/z 506.4g/mol, Calcd for $C_{23}H_{22}O13$;Named myricetin-3-O-(4$^{//}$-O-acetyl)-α-rhamnopyranoside.

Compound 10. Pale-yellow amorphous solid. (MeOH); mp 252-254°C; [α] $^{24}_{D}$ -68,6° (c 0.15, MeOH); UV λ_{max} 267 (4.35), 315 (4.45), 355 sh (4.29) nm (MeOH+NaOMe) 280, 315, 378 nm: ^{1}H- NMR (MeOH-d_4): δ 6.15 (1H, *d,J*=2.2 Hz, *H-6*), 6.38 (1H, *d,J*=2.2 Hz, H-8), 7.97 (2H, *d, J*= 9.0, Hz, *H-2′, 6′*), 6.85 (2H, *d, J*=9.0 Hz, H-3′,5′), 5.45 (1H, d, J=7.8 Hz, H-1″), 3.45 (1H,*dd*, J=7.1 Hz H-2″), 3.47 (1H, m, Hz, H-3″), 3.31 (1H, m, H-4″), 4.16 (2H, *dd*, J=11.6, 6.6, Hz, H-6″), cis-p-coumaric acid 6.78 (2H, d, J=8.6, Hz, H-3‴, 5‴), 7.36 (2H, d, J=8.6, Hz, H-2‴, 6‴), 7.33 (1H, d, J=16.0, Hz, H-7‴), 6.11 (1H, d, J=16.0, Hz, H-8‴); ^{13}C – NMR (MeOH): 160.1 (C-2), 136.0 (C-3), 180.0 (C-4), 163.7 (C-5), 101.1 (C-6), 167.6 (C-7), 95.8 (C-8), 159.3 (C-9), 106.2 (C-10), 123.6 (C-1′), 133.0(C-2′), 116.8 (C-3′), 162.3 (C-4′), 116.8 (C-5′), 133.0 (C-6′); 104.9 (C-1″), 78.8 (C-2″), 76.5 (C-3″), 72.5 (C-4″), 76.6 (C-5″), 65.1 (C-6″), 169.6 (C-1‴), 115.6 (C-2‴); 147.4 (C-3‴), 127.9 (C-4‴), 132.0(C-5‴); 117.6 (C-6‴), 162.0 (C-7‴), 117.6 (C-8‴), 132.0 (C-9‴); The positive ion FABMS of compound 10 showed molecular ion peaks at m/z EIMS m/z 617 [M+Na], and 595.0 [M+N] corresponding to the molecular formula $C_{30}H_{26}O_{13}$ with is consistent with the presence of 30 carbon signals in it's decoupled ^{13}CNMR spectrum. UV absorption maxima of compound 10 in MeOH () and with 5,7,4′-trioxygenation. The presence of para- substituted B- ring in compound 10 was evident from the presence of two A2B2 doublets et 6.85 and 7.97 attributed to 3′, 4′ and 2′,6′ protons respectively in it's^{1}H-NMR spectrum. Two *meta*-coupled signals at δ 6.15 and 6.38 were assigned to H-6and H-8 protons respectively of A ring. These data together indicate that the aglycone moiety is kaempferol and the ^{13}C-NMR spectrum of compound 10 was comparable to that of kaempferol is self.Named kaempferol-3-O-β-D-(6″-O-*E-p-coumaric acid*)-glucopyranoside [Maheswara. M., et al 2006].

Compound 11. A pale yellow amorphous powder (MeOH); mp 172-173 °C; [α] $^{24}_{D}$ -165.2° (c 0.65, MeOH); UV λmax nm (MeOH): 255, 290, 375; IR (KBr) νmax cm^{-1}: 3400 (OH), 1670, 1600; EIMS m/z (rel. int): 286 ([M-rhamnosyl]$^{+}$, 100), 285 (50), 258 (23), 229 (40); ^{1}H NMR (MeOH): δ 0.92 (3H, d, J = 5.6 Hz, H-6″), 3.32 (1H, m, H-5″), 3.35 (1H, t, J = 9.2 Hz, H-4″), 3.70 (1H, *dd*, J = 9.2, 3.6 Hz, H-3″), 4.22 (1H, *dd*, J = 3.6, 1.6 Hz, H-2″), 5.37 (1H, d, J = 1.6 Hz, H-1″), 6.19 (1H, d, J = 2.0 Hz, H-6), 6.35 (1H, d, J = 2.0 Hz, H-8), 6.93 (2H, d, J = 8.8 Hz, H-3′ and H-5′), 7.76 (2H, d, J = 8.8 Hz, H-2′ and H-6′); ^{13}C-NMR 158.5 (C-2), 136.2 (C-3), 179.5 (C-4), 163.1.3 (C-5), 99.8 (C-6), 165.8 (C-7), 94.7 (C-8),159.2 (C-9), 105.9 (C-10), 122.6 (C-1′), 131.9 (C-2′), 116.5 (C-3′), 161.5 (C-4′), 116.5 (C-5′), 131.9 (C-6′), 103.4 (C-1″), 71.9 (C-2″), 72.2 (C-3″), 73.1 (C-4″), 71.8 (C-5″), 17.6 (C-6″); HR-FAB-MS (negative mode) *m/z* 489.105[M-N]$^{-}$, Calcd for $C_{21}H_{21}O_{10}$; Named kaempferol-3-O-α-L-rhamnopyranoside [Chen. C.Y., et al.,2004].

Compound 12. Yellow needles (MeOH); ^{1}H- NMR (MeOH-d_4): δ 6.49 (1H, d, J=1.5 Hz, *H-6*), 6.83 (1H, d, J =1.5 Hz, H-8), 8.02 (2H, d, *J=8.5, H-2',* H-6′);7.14(2H, d, *J=8.5*, H-3′, *H-5′);* 3.85 (3H,s, H-4′), 4.54 (1H, br, s, H-1″), 3.66 (1H, *dd*, *J=4.0*; 1.5 Hz, H-2″), 3.44 (1H, *m*, H-3″), 1.06 (3H, *d,J*=6.5 Hz, H-6″), 0.812 (3H, *d,J*=6.2 Hz, H-8″); ^{13}C – NMR (MeOH): 164.0 (C-2), 103.8 (C-3), 182.1 (C-4), 161.1 (C-5), 99.8 (C-6), 162.7 (C-7), 94.9 (C-8), 157.0 (C-9), 105.5 (C-10), 122.7 (C-1′), 128.5 (C-2′), 114.8 (C-3′), 162.5 (C-4′), 114.8 (C-5′), 128.5 (C-6′); 55.6 (C-4′, OCH_3), 100.5 (C-1″), 70.4 (C-2″), 70.8 (C-3″), 72.1 (C-4″), 68.4 (C-5″), 17.8 (C-6″), 172.7 (C-

Vol. 5, No. 06; 2021

ISSN: 2581-3366

$7^{//}$), 21.0 (C-$8^{//}$); EIMS m/z 476.43g/mol, Calcd. for $C_{24}H_{23}O10$; Namedacacetin-7-O-β-($4^{//}$-O-acetyl)-α-L-rhamnopyranoside [Selenge. E., 2013].

Table 3. 1H and 14C-NMR Spectroscopic Data (MeOH) Compounds 5-8

	9		10		11		12	
Position	δ_H *(J in Hz)*	δ_C	δ_H *(J in Hz)*	δ_C	δ_H *(J in Hz)*	δ_C	δ_H *(J in Hz)*	δ_C
2	-	159.8	-	160.1	-	158.5	-	165.82
3	-	135.5	-	136.0	-	136.2	6.9 (1H, s)	102.6
4	-	179.5	-	180.0	-	179.1	-	179.5
5	-	166.0	-	163.7	-	163.1	-	116.5
6	6.21 (1H, d,2.1)	99.4	6.15 (1H, *d*, 2.2)	101.1	6.20 (1H, *d*, *2.0*)	99.8	6.21 (1H, *d*, *1.5*)	99.8
7		163.2	-	167.6		165.8	-	172.0
8	6.37 (1H,d, 2.1)	94.8	6.38 (1H, *d*, 2.2)	95.8	6.37 (1H, *d*, *2.0*)	159.2	6.38 (1H, *d*, 1.5)	94.8
9	-	158.6	-	159.3	-	159.5	-	159.8
10	-	105.9	-	106.2	-	105.9	-	109.5
1′	-	121.8	-	123.6	-	122.6	-	121.7
2′	6.9 (2H, s,)	99.8	7.97 (1H, *d*, 9.0)	133.0	7.74 (2H, *d*,8.8)	121.9	7.5 (1H, *d*,*8*.5)	127.0
3′	3.36 (1H, *dd*, 9.8;6.2)	147.0	6.85 (1H, *d*, 9.0)	116.8	6.91 (2H, *d*, 8.8)	116.5	6.96 (1H, *d*, *8*.5)	116.5
4′	4.82 (1H, *t*, 9.8; 6.2)	137.8	-	162.3	4.22 (1H, *dd*, 6.2)	161.5	-	163.25
5′	3.36 (1H, *dd*, 9.8; 6.2)	147.0	6.85 (1H, *d*, 9.0)	116.8	6.91 (2H, *d*, 8.8)	116.1	6.93 (1H, *d*,*8.5*)	116.5
6′	6.9 (2H, s,)	99.8	7.98 (1H, *d*, 9.0)	133.0	7.78 (2H, *d*,8.8)	131.9	7.5 (1H, *d*,*8.5*)	128.5
4′- OCH₃	-	-	-	-	-	-	4.71 (3H, s)	55.6
Sugar-I	*Rhamnoside*		*glucopyranoside*	-	*Rhamnoside*		*Rhamnoside* `	
Rha-1″	5.46 (1H, *d*, 1.6)	103.4	5.45 (1H, *d*, 7.8)	104.9	5.38 (1H, *d*, *1*.6)	103.4	5.5 (1H, *d*, 1.6)	94.7
Rha-2″	4.21 (1H, *d*, 3.4; 1.6)	71.6	3.45 (1H,*dd*,*7.1*)	78.8	4.22 (1H, *dd*, 3.6, 1.6)	71.9	4.71 (1H, *dd*, *4.0*, 1.5)	70.05
Rha-3″	3.92 (1H, *dd*, 9.8; 6.2)	72.2	3.47 (1H, m)	76.5	3.70 (1H, *dd*, 9.2; 3.6)	72.2	3.35 (1H, *m*)	75.06
Rha-4″	-	75.1; 172.7	3.31 (1H, m)	72.5	3.34 (1H, *t*,9.2)	73.1	-	69.5
Rha-5″	-	69.6	-	76.6	3.31 (1H, *m*)	71.8	2.32 (1H, *d*, 6.5)	71.6
Rha-6″	0.80 (3H, *d*, 6.2)	17.7	4.16 (2H, *dd*, *6.6*)	65.1	0.92 (3H, *d*, 5.6)	17.6	0.78 (3H, *d*, 6.2)	17.8
-C=O′	-	172.6	-	-			-	172.7
- CH_3′	0.812 (3H, *d*, 6.2)	21.0	-	-			0.77 (3H, *d*, 6.2)	21.0
p-coumaryc acid								
C-1‴			-	169.6				
C-2‴			6.78 (1H, *d*, *8.6*)	115.6				
C-3‴			7.36 (1H, *d*,*8.6*)	147.4				
C-4‴			-	127.9				
C-5‴			7.36 (1H, *d*, *8.6*)	132.0				
C-6‴			6.78 (1H, *d*, *8.6*)	117.6				
C-7‴			7.33 (1H, *d*, *1*6.0)	162.0				
C-8‴			6.11 (1H, *d*, *16.0*)	117.6				
C-9‴			-	132.0				

	5		6		7		8	
Position	***δ_H (J in Hz) proton***	**δ_C atom**	**δ_H (*J* in Hz) proton**	**δ_C atom**	**δ_H (*J* in Hz) proton**	**δ_C atom**	**δ_H (*J* in Hz) proton**	**δ_C atom**
2	-	146.9	-	156.5	-	159.8	-	159.8
3	-	135.5	-	134.0	3.29 (1H, *m*)	135.5	-	135.5
4	-	175.8	-	177.6	-	179.5	-	179.5
5	3.34,(1H, *m*)	160.7	3.34,(1H, *m*)	161.3	3.30 (1H, *m*)	166.0	3.30 (1H, *m*)	166.0
6	6.18 (1H, *d*, 2.0)	98.2	6.18 (1H, *d*, 2.0)	98.9	6.16 (1H, d,2.1)	99.4	6.21 (1H, d,2.1)	99.4
7	3.35	163.9	-	164.6	3.30	163.2		163.2
8	6.39 (1H, *d*, 2.0)	93.3	6.56 (1H, *d*,2.0)	93.7	6.37 (1H,d, 2.1)	94.8	6.37 (1H,d, 2.1)	94.8
9	-	156.2	-	157.5	-	158.6	-	158.6
10	-	103.1	-	104.0	-	105.9	-	105.9
1′	-	122,1		121.0		121.8	-	121.8
2′	7.65 (1H, *d*, 2.0)	115.3	7.30 (1H, *d*,2.0)	115.5	6.36 (2H, s,)	99.8	6.9 (2H, s,)	99.8
3′	3.37(1H, *m*)	145.0	6.22 (1H, *d*, 2.0)	145.3	3.29 (1H, *dd*, 9.8; 6.2)	147.0	3.36 (1H, *dd*, 9.8; 6.2)	147.0
4′	3.30 *(1H,s)*	147.6	6.40 (1H,*dd*, 9.9, 1.0)	148.6	3.30 (1H, *t*, 9.8; 6.2)	137.8	4.82 (1H, *t*, *J*=9.8; 6.2, Hz)	137.8
5′	6.88 (1H, *dd*, 8.4)	115.6	6.9 (1H, *d*, 8.3)	115.8	3.29 (1H, *dd*, 9.8; 6.2)	147.0	3.36 (1H, *dd*, 9.8; 6.2)	147.0
6′	7.36 (1H, *dd*, 8.4)	121.6	7.24 (1H, *d*, 8.3, 2.0)	120.6	6.36 (2H, s,)	99.8	6.9 (2H, s,)	99.8
Sugar-I								
Glc-1″			4.72 (1H, *d*, 1.7)	101.5			4.62 (1H, *d*,*7.5*)	102.4
Glc-2″			5.24 (1H,*d*, 1.0)	70.0			3.25 (1H, *d*, 3.4; 1.6)	83.1
Glc -3″			2.01 (1H, *s*)	67.9			3.45 (1H, *dd*, 9.8; 6.2)	76.1
Glc -4″			3.4 (1H, *dq*, 9.9, 6.3)	73.2			3.18 (1H, t, 9.0)	69.2
Glc -5″			3.75 (1H, *dq*, 9.9, 3.3)	67.9			3.45 (1H, m)	76.5
glc-6″			4.04 (1H, *dd*, 3.0, 1.0)	17.1			3.40 (1H, *dd*, 11.5, 5.0)	60.3
Ac C=O′			-	170.0.			-	-
Ac CH_3′			0.94 (3H, *d*, 6.3)	20.9			-	-
Sugar-II								
Rha-1‴							4.54 (br, s)	100.5
Rha-2‴							3.66 (1H, *dd*, 4.0, 1.5)	70.4
Rha-3‴							3.44 m	70.8
Rha-4‴							3.15 (1H, *t*, 9.5)	72.1
Rha-5‴							-	68.4
Rha-6‴							1.06 (3H, *d*, 6.5)	17.8

Table 3-2. 1H and 14C-NMR Spectroscopic Data (MeOH) Compounds 9-12

Vol. 5, No. 06; 2021

ISSN: 2581-3366

Discussion

Matsuda et al. isolated diarylheptanoids glycosides1.7-bis (4 hydroxyphenol) -3-heptene-5-on) from *B.platyphylla var.*Japonica and found that the compounds have liver protective, anti-oxidant, anti-cancer properties [Matsuda. H et.al, 1998; En.J, et al., 2004].

B.platyphyllavar. japonica leaves' contains linear and cyclic diarylheptanoids which has anti-inflammatory, anti-bacterial, anti-yeast infection and liver intoxication effects [Fuchino H et al., 1996] as well as with anti-cancer effect.

Diarylheptanoids were initially found in *Zingiber, Curcuma, Alpine, Alnus,* and *Myrica* [Ibrahim. S. R. M, et al., 2016]. In the recent years, *Curcuma longa* of turmeric is commonly used in Indian and Chinese traditional medicine to treat gallbladder, skin and stomach diseases and found to have anti-cancer and liver protection properties. Cyclic diarylheptanoids were found *Juglans sinensis,* which is commonly used in the traditional medicine of South Korea**.**

Diarylheptanoids from ether fraction of *B.Hippolytii*'s leaves was extracted the macro cycle substances heptane with of two aromatic rings joined by a linear seven carbon chain (heptane). Basic chemical name is a 1,7 diphenyl heptane and the structures had open chain linear or cyclic compounds, diarylheptanoids are typical secondary metabolites

This structure was proven to be present in the leaves of *B.Hippolytii* and this is the first research to identify the structure of the compound.

Acer nikoense is rich in acerogenin C and is used to treat liver and eye diseases. Cyclic structure of acerogenin has various medical effects. The alnusonon, alnusonol had tautomer's *keto* and *enol* shapes and have transitioning between each other. These compounds were initially found in *A.japonica, A.hirsuta, Carpinus cordata,* and *Myrica nana*. The cyclic diarylheptanoids were assayed for α-glycosidase inhibitory activities. In comparison the IC_{50} values of compounds of 1, 2 for α-glycosidase inhibition were 1.35, 8.69 and 2.34 µg/ml. In comparationthe IC_{50} value of acarbose, as a positive control for α-glycosidase inhibition, was 451µg/ml. That compounds have a stronger inhibitor effect than acarbose. [Chiba. K., et al., 2013]. Antioxidant active of diarylheptanoids were detected high strong antioxidant effect by the comparative study with α-tocopherol and L-ascorbic acid.The antioxidant property of the compound-3 acerogenin Kwas compared against α-tocopherol and shown strong anti-oxidant effect [Ren. X, et al., 2017].

In addition, in the recent years, the number of studies about anti-cancerous properties of the compound-1 was alnusonon, compound-2 was alnusonol and the compound-3 Acerogenin Khas been increasing.

The compound's 4 obtained and established from birch leaves *B.Hippolytii*. 3,5'-dihydroxy-4'-methoxy-3,4''-oxy-1,7-diphenyl-1-heptene isolated from inner bark of *B.davurica*have been investigated in earlier studies [Fuchino. H., et al., 1998].

The flavonoids in birch leaves extracts have antioxidant effect and reduce blood glucose level (Molocobskhii DS, Diyachuk GI. 2006). Phytochemical analysis of *B.Hippolytii* leaves extract

was used to extract flavonoid and its glycosides 8 compounds: quercetin, quercetin 3-O-(4-O-acetyl)-α-L-rhamnopyranoside, myricetin, myricetin 3-O-β-glucopyranosyl-6-O-rhamnopyranoside, myricetin3-O-(4-O-acetyl)-α-rhamnopyranoside, kaempferol-3-O-(4-para-coumaric acid)-α-L-rhamnopyranoside, kaempferol-3-O-α-L-rhamnopyranoside, acacetin-7-O-β-rhamnopyranoside. These compounds were also found in *B.Hippolytii Sukacz* leaves extract. Their sub groups of flavonols including quiercetin, keampferol, myricetin and their glycosides with acetylated and dismissed coumaric acid. The flavonoids of *B.pubescens* leaves have been identified already. Flavonoid myricetin3-O-(4-O-acetyl)-α-rhamnopyranoside in high concentration in silver birch leaves,the acetylated form quercetin 3-O-(4-O-acetyl)-α-L-rhamnopyranoside this compound present in the leaves white birch in a reasonable amount but it was not detected in the leaves of silver birch at all [Ossipob. V, et al., 1996].

A number of clinical and research studies have suggested that flavonoids have positive effect in the treatment, prevention and alleviation of various viral diseases, degenerative diseases [Hossain. M K., et al., 2016]. The ant carcinogenic, ant mutagenic and cardio protective effects reported are generally associated with the flavonoids' antioxidant properties. Flavonoids as reducing agent and donors of hydrogen and free radical scavengers [Aaby.K, et al, 2004].

Conclusions

As result of the *B. Hippolytii* leaves' chemical components study compounds were obtained by physical chemical spectroscopic and MS methods.

Alnusonol (4.4 mg), Alnusonon (5.6 mg), Acerogenin K (3.4 mg) and ether of diarylheptanoid 3, 5' dihydroxy-4' methoxy 3', 4''-oxo -1, 7- diphenyl–heptene-1 (6.5 mg). Flavonoids and their glycosides quercetin (1.6 mg), quercetin-3-O-(4-O-acetyl)-α-L-rhamnopyranoside (35.5 mg), myricetin (1.0 mg), myricetin-3-O- rutinoside (1.0 mg), myricetin-3-O-(4-O-acetyl)-α-L-rhamnopyranoside (8.2 mg), keampferol-3-O-β-D-(6$^{//}$-O-*E-p-coumaric acid*) glucopyranoside (2.9 mg), keampferol-3-O-α-L-rhamnopyranoside (11.9 mg) and acacetin-7-O-(4-O-acetyl)-α-L-rhamnopyranoside (9.9 mg). All compounds were isolated for the first time from this leaves *B.Hippolytii*. This is the first research in the birch leaves were used in such study.

References

Ali Esmail Al-Snafi., 2015. The medical impontence of Betula alba- An overview, Journal of Pharmaceutical biology, 5(2), 99-103

Chen. C. Y., et al.,2004 Substituent chemical shift of phamnosides from the stems of Cinnamomum osmopheum, The Chinese Pharmaceutical Journal, 56, p 141-146.

Dehelean C. A et al., 2006.Characterization of birch tree leaves, buds and bark dry extracts with antitumor activity, Journal of optoelectronics and advanced materials vol 9, 3, p 783-787

Penkov. D., 2015. Biological activity of Bulgarian folia Betulae dry extract, International journal of pharmacy and pharmaceutical sciences, vol 7. Issue 7, p 289-294.

Ju. E. M., et al., 2004. Antioxidant and anticancer activity of extract from Betula platyphylla var.Japonica, Life sciences, 74, 1013-1026,

So. H.M, et al., 2018. Bioactivity evaluations of betulin identified from the bark of Betula platyphylla var. japonica for cancer therapy, Arch Pharm Res. vol. 41(8): pages 815-822. Doi: PMID: 30109574DOI: 10.1007/s12272-018-1064-9

Fuchino. H., et al., 1998. Chemical evolution of Betula species in Japan Constituents of Betula daburica, Chem. Pharm. Bull 46(1), 166-168.

Fuchino. H., et al., 1996. Chemical evolution of Betula species in Japan Constituents of Betula platyphylla var japonica, Chem. Pharm. Bull 44(5), 1033-1038.

Haining. L.V and Gaimei She., 2010. Naturally Occurring Diarylheptanoids, Natural Product Communications Vol. 5 (10), 1687 – 1708

Matsuda. H., et al., 1998. Hepatoprotective, superoxide scavenging, and antioxidative activities of aromatic constituents from the bark of Betula Platyphilla Var Japonica, Bioorganic and Medicinal chemistry Letters, 8, 2939-2944

Hossain. M K., et al., 2016. Molecular mechanisms of the anti-obesity and anti-diabetic properties of flavonoids, International journal of Molecular Sciences, vol. 17, 569; doi103390/ ijms17040568, www.mdpi.com/journal/ijims.

Gruvob.V. L., 2008. Key to the vascular plants of Mongolia, Gan printing company, pages 91-93, UB.

Huh.J. Y, Lee.S, Ma. E.B, Eom. H.J, Baek. J, Ko. Y.J, Kim. K.H.,2018. The effects of phenolic glycosides from Betula platyphylla var. japonica on adipocyte differentiation and mature adipocyte metabolism. J Enzyme Inhib Med Chem. 33(1): 1167–1173. (PMID:30126307 PMCID:pmc6104606)

Xiong. J., et al.,2016. Phytochemical characterization and anti-inflammatory properties of Acacia mearsnii leaves, NPC, vol 11, (5), 649-653.

Chiba. K., Ichizawa. H, Kawal. S., Nishida. T.,2013. α- Glycosidase Inhibition Activity by Cyclic Diarylheptanoids from Alnus sieboldiana, J. Wood Chem Tech, vol 33, page 44-51

Nomura. M, Tokoroyama. T, Kubota. T., 1981. Biarylheptanoids and other constituents from wood of Alnus Japonica, Phytochemistry, vol 20, No. 5, pp1097-1104

Maheswara M., et al 2006. Antibacterial activity of acylated flavonol glycoside from Waltheria Indica, Asian Journal of chemistry, vol. 18(4), 2761-2765.

Cho. N, et al., 2016. Preparative of anti-proliferative Diarylheptanoids from Betula Platyphylla by High speed counter-current chromatography, Molecules, 21, 700, 3-12

Novaković M et al., 2013.Diarylheptanoids from Alnus glutinosa Bark and Their Chemoprotective Effect on Human Lymphocytes DNA, Planta Med 79: 499–505.

Ossipob. V., et al., 1996. High performance liquid chromatographic separation and identification of phenolic compounds from leaves of Betula pubescens and Betula pendula, Journal of Chromatography A, 721, 59-68

Ibrahim. S. R. M, Mohamed. G. A, Amgad. I. M, Aljaed. B. A., 2016. Alnuheptanoid B: A New

Cyclic Diarylheptenoid from Alnus japonica stem bark, Rec. Nat.Prod10:3,pages 362-368.

Ogura T, Usuki T. 2013. Total sinthesis of acerogenins E, G, and K, and centrolobol. Tetrahydron.;69:2807-2815.

Otgonbayar Ch., et al 2017. Study result isolated betulin, lupeol from bark of birch in Mongolian, Mongolian Akademy Sciences, vol 57 (3) 223

Kim. S.Y., et al.,1999. Ant oxidative flavonoids from the leaves of Morus alba, Arch Pharm Res, vol. 22 (1), p.81-85.

RastogiS., et al., 2015. Medicinal plants of the genus Betula- Traditional uses and a phitochemical - pharmacological review, Journal of Ethnopharmacology, 159, 62-83,

Terazawa. M, Takuya. K, Okuyama. H, Miyake M, 1984. Platyphylloside, a new diarylheptanoid glucoside from Shirakamba (B. plathyphylla), Mokuzai gakkaishi vol. 30, (5), 391-403

Ren. X et al., 2017. The genus Alnus, A comprehensive outline of its chemical constituents and biological activities, Molecules, 22 (1383), p2-17.

Chang. Y.C, et al., 2000. The constituents of Lindera glauca, J.Chin.chem.Soc. (47) 373-380

Jahng. Y, Park. J. P, 2018. Recent Studies on Cyclic 1,7-Diarylheptanoids: Their Isolation, Structures, Biological Activities, and Chemical Synthesis, Molecules, 23, 3107, p 2-42

Ministry Education and Science of Mongolia., 2014. The study ingredients traditional medicine of Traditional medical of Mongolia, pages 320, UB

Volodya Ts., 2014. Method using medicinal plants of Mongolia in medicine, Vitpress printing company, pages 390-395, UB

Ligaa U.,Davaasuren B., Ninjil N., 2006. Medicinal plants of Mongolia used in Western and Eastern medicine, JKL printing, pages 99, 333, 435-436. UB

Kozhamkulova. Z. A, et al., 2010. Gmelinoside I, new flavonol glycoside from Limonium gmelinii, NPC, vol. 5 (7), p. 1061-1062.

Selenge. E., 2013.Studies on phytochemical constituents and their biological activities from Mongolian Medicinal plants, Dracocepalum and Chamaerhodos species, PhD in Pharmaceutical sciences. Tohoku Pharmaceutical University, Sendai, Japan