

Functional Group Determination of some Compounds from the Roots of *Homonoia riparia* Lour by FT- IR Analysis

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Abstract:- The roots of *Homonoia riparia* Lour. (Local name- Kyauk- kant- nanthar) were selected for this research. Phytochemical screening of the crude extracts was done by means of standard method. The sample consists of alkaloids, flavonoids, steroids, terpenes, glycosides, reducing sugars, polyphenols, saponins and phenolic compounds respectively. Some organic compounds (1- 5) could be isolated from the roots of *Homonoia riparia* using column chromatography. Finally, the functional groups of the isolated compounds were determined by Fourier Transform Infrared (FT-IR) spectroscopy.

Keywords:- *Homonoia Riparia* Lour., Phytochemical Screening, Column Chromatography, FT-IR Spectroscopy.

I. INTRODUCTION

Plants have been used as one of the most important sources of medicines since ancient times, and numerous currently prescribed drugs are derived from natural sources such as plants, animals, fungi and bacteria, especially from plants. [1] Most of the people who live in rural area in Myanmar still depend on the traditional medicines derived from medicinal plants. There are a lot of traditional medicinal plants in Myanmar. Some of them have been scientifically investigated but most of them are still needed to be determined.

Homonoia is a small genus of shrubs which belongs to the Euphorbiaceae family that is widespread in Asian countries, and found commonly at riverbanks. [2- 6] The whole plant of *H. riparia* (Euphorbiaceae) is claimed to be active against various ailments like constipation, emesis, piles, bladder stones, gonorrhoea, syphilis, toothache, angina, malaria, and wounds caused by scorpion and fish bites [6]. The roots are used as laxative, diuretic, refrigerant, depurative, and emetic properties, and their decoction is also used to treat urinary calculi, urinary discharges, urinary infection, malaria, antiseptic, inflammation, ulcers, bladder stones, chest pain, hepatitis, joint gall, stomach ache, gonorrhoea, hemorrhoids, syphilis, thirst and fungal infections. [1-4]

Some triterpenes and quercetin glycoside have been isolated from the leaves of *H. riparia*. [2, 3] Some organic compounds such as sterols, taraxerone, taxerol, lupenol, gallic acid, β -acetyl aleuritic acid have been isolated from

the heart wood and bark of *H. riparia*. In addition, riparsaponine and other six known compounds were also reported from the stem of *H. riparia*. [2, 4] Some active compounds which are used in the traditional medicine to treat hepatitis, bellyache and scald were isolated and identified from the leaves and roots of *H. riparia*. [7, 8] In the current study, some organic compounds could be isolated from the roots of *H. riparia* using chromatographic techniques and the functional groups of the isolated compounds were assigned using FT- IR spectral data.

II. MATERIALS AND METHODS

A. General

Analytical grade reagents and solvents were used without further purification. Silica gel (Merck Co. Inc, Kiesel gel 60F₂₅₄, 70-230mesh) was used for Column Chromatographic separation. Pre-coated silica gel (Merk Co. Inc, Kiesel gel 60 F₂₅₆) plate was applied for thin layer chromatography. UV-Lamp (Lambda – 40, Perkin – Elmer Co, England) and iodine vapor were used as developing agents in column chromatography. FT-IR spectrometer (Shimadzu, Japan) was used for the identification of the functional groups of the isolated compounds.

B. Sample Collection

The roots of *H. riparia* (Kyauk-kant-nanthar) were collected from Monywa Township, Sagaing Region, Myanmar and identified by Dr Soe Myint Aye, Department of Botany, Mandalay University, Myanmar.

C. Preliminary Phytochemical Screening

The phytochemical tests of the crude extracts of the root sample were carried out to detect the different types of chemical constituents in the sample using the reported methods. [9]

D. Extraction and Isolation of Organic Compounds

The air-dried powdered sample (500 g) was extracted with 95% ethanol (2 L) for 2 months. It was concentrated and was successively extracted with ethyl acetate. The ethyl acetate crude extract (4.53 g) was packed with 60g of silica gel in a column (65cm x 2.5cm) and different mixtures of n-hexane and ethyl acetate from non-polar to polar were used as eluents. The progress of separation was monitored by thin layer chromatography using n- hexane and ethyl acetate mixtures (non-polar to polar) as solvents s. Twelve combined fractions with same R_f values were obtained.

The combined fractions IV, VI, VIII and IX have found to be main portions. From the further purification with micro-column separations, combined fraction IV, VI, VII and IX gave the compounds (1-5). The compounds (1) and (3) were obtained as white crystal form while the others were isolated as pale yellow crystals. The weights of the isolated compounds (1-5) were found as 12.8 mg, 7.9 mg, 10.5 mg, 9.3 mg and 29.1 mg respectively.

III. RESULTS AND DISCUSSION

A. Preliminary Phytochemical Screening of the Roots of *Homonoia riparia* Lour.

The results obtained from the phytochemical tests of the roots of Kyauk-kant-nanthar showed the presence of terpenoids, phenolic compounds, glycosides, reducing

sugars, tannins, saponins, polyphenols, steroids and flavonoids respectively.

B. Functional Group Determination of Compound (1)

In the FT-IR spectrum of compound (1), the peak at 2924.19 and 2853.98 cm^{-1} are due to the asymmetric and symmetric C-H stretching vibrations of sp^3 hydrocarbons. The sharp peaks appeared at 1738.15 and 1713.77 cm^{-1} are the C=O stretching vibration of carbonyl groups. The bands at 1462.86 cm^{-1} should be the C-H in plane bending vibration of sp^3 hydrocarbons. The C-CO-O-C stretching vibration of ester group is observed at 1174.08 cm^{-1} . The compound (1) contains the sp^3 hydrocarbon and carbonyl and ester functional groups from the spectral data in figure (1). [10]

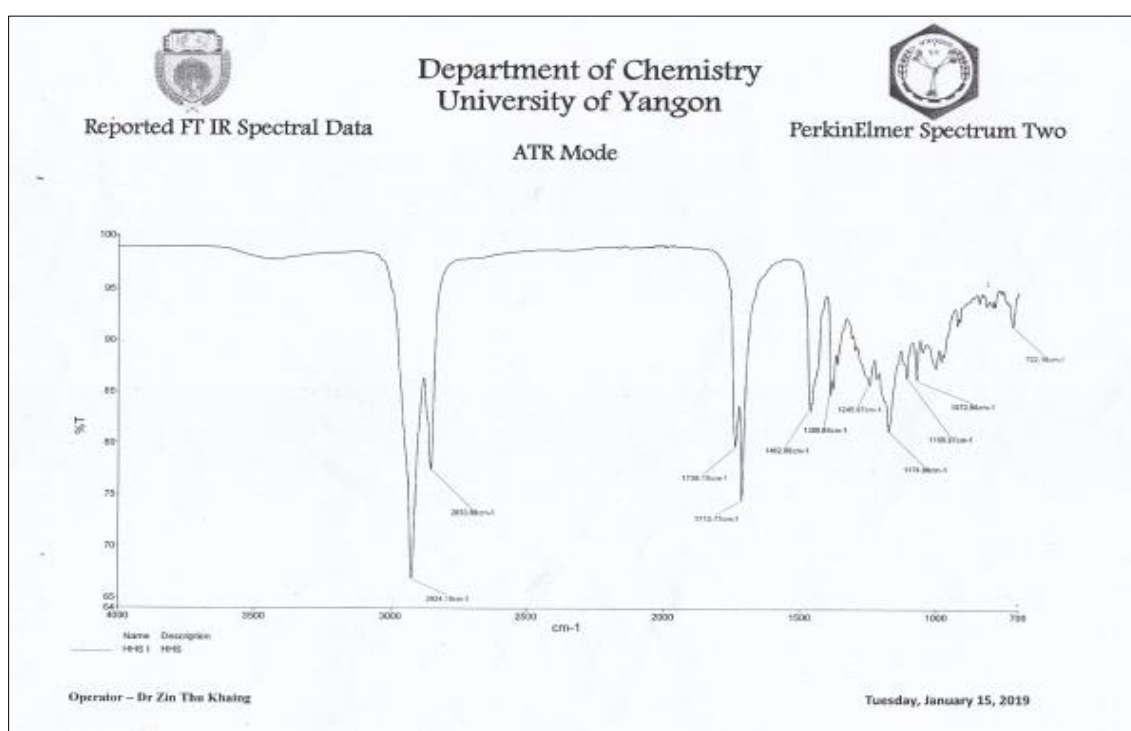


Fig 1:- FT- IR Spectrum of Compound (1)

C. Functional Group Determination of Compound (2)

The broad band around 3500 cm^{-1} in the Figure (2) of compound (2) shows O-H stretching vibration of alcohol group. The peak at around 3050 cm^{-1} represents the C-H stretching vibration of sp^2 hydrocarbons. The peaks appeared at 2924.43 and 2854.53 cm^{-1} are due to the asymmetric and symmetric C-H stretching vibrations of sp^3 hydrocarbons. The strong absorption band at 1710.50 cm^{-1} shows the C=O stretching vibration of carbonyl groups. The C=C stretching vibration of sp^2 hydrocarbons was

observed at around 1600 cm^{-1} . The bands which occur at 1462.76 cm^{-1} should be the C-H in plane bending vibration of sp^3 hydrocarbons. The OH in plane bending vibration of alcohol group was observed at 1379.4 cm^{-1} . The peak at 1270.83 cm^{-1} is due to the C-CO-O-C stretching vibration of ester group. The peaks at 1121.93, 1072.62 cm^{-1} show the C-O-CO-C bending vibration of ester groups. According to the FT- IR spectral data, the compound (2) contains the hydroxyl, sp^2 hydrocarbons, sp^3 hydrocarbons, carbonyl groups and ester functional groups respectively.

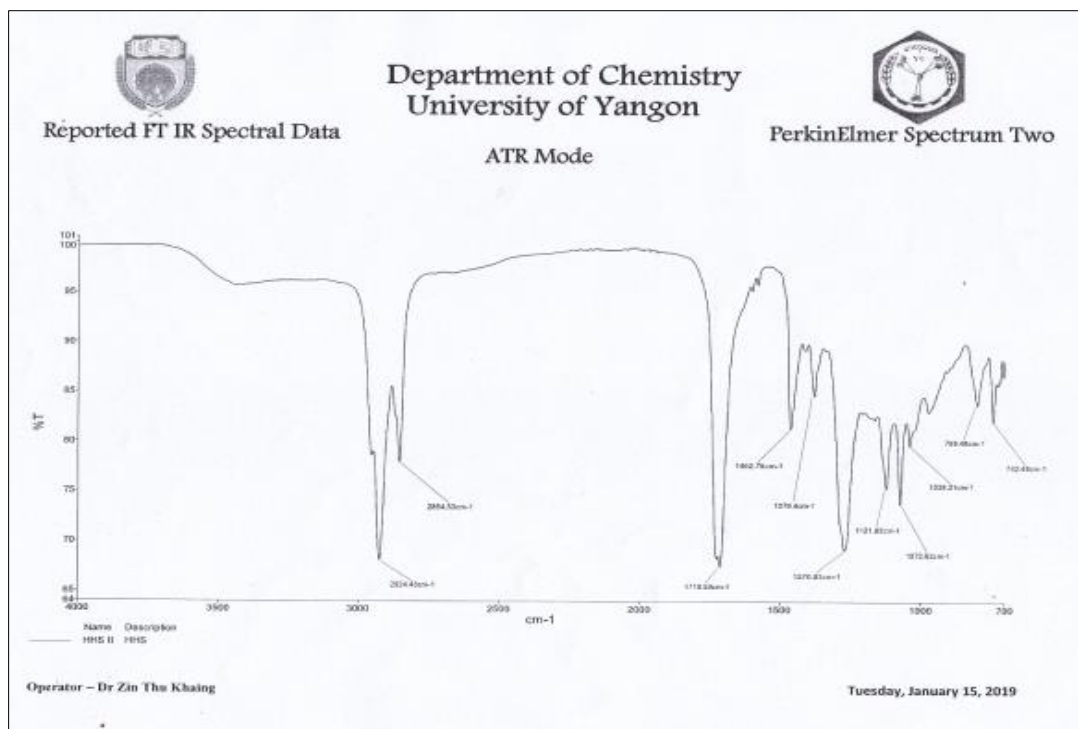


Fig 2:- FT- IR Spectrum of Compound (2)

D. Functional Group Determination of Compound (3)

In the FT-IR spectrum of compound (3), the broad band around 3450 cm⁻¹ indicates the O-H stretching vibration of alcohol. The peaks at 2924.12 and 2854.01 cm⁻¹ are due to the asymmetric and symmetric C-H stretching vibrations of sp³ hydrocarbons. The peak at 1707.72 cm⁻¹ shows the C=O stretching vibration of carbonyl groups. The bands which occur at 1462.90 cm⁻¹ should be the C-H in plane bending vibration of sp³ hydrocarbons. The OH in

plane bending vibration of alcohol was observed at 1377.84 cm⁻¹. The C-O stretching vibration of alcohol group was observed at 1249.46, 1178.61, 1030.57 cm⁻¹. The peak at 891.34 cm⁻¹ is due to the C-H out of plane bending vibration of sp³ hydrocarbons. From the FT- IR spectral data, the compound (3) consists of the alcohol, sp² hydrocarbons, sp³ hydrocarbons and carbonyl functional groups respectively.

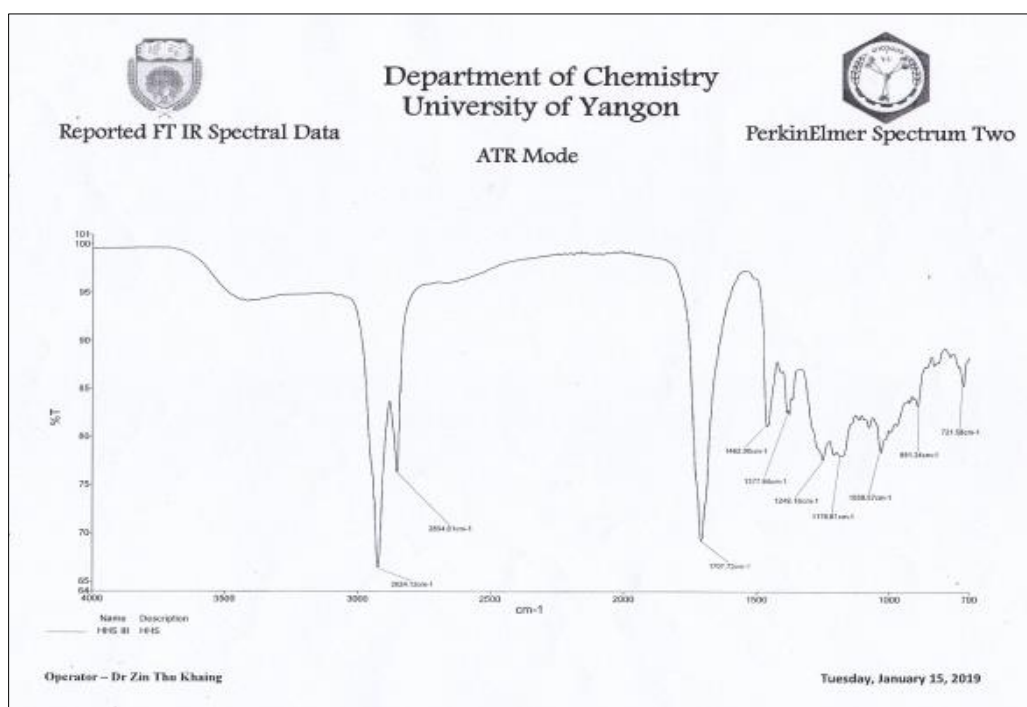


Fig 3:- FT- IR Spectrum of Compound (3)

E. Functional Group Determination of Compound (4)

In figure (4), the broad band around 3400 cm^{-1} indicates the O-H stretching vibration of alcohol. The C-H stretching vibration of sp^2 hydrocarbons is observed at around 3040 cm^{-1} indicating the presence of sp^2 hydrocarbons. The asymmetric and symmetric C-H stretching vibrations of sp^3 hydrocarbons are observed at 2927.34 and 2857.98 cm^{-1} . The strong absorption of carbonyl group is found at 1723.91 cm^{-1} . The C=C stretching vibration of sp^2 hydrocarbons is appeared around

1600 cm^{-1} . The band occurred at 1461.90 cm^{-1} is due to the C-H in plane bending vibration of sp^3 hydrocarbons. The OH in plane bending vibration of alcohol was observed at 1379.13 cm^{-1} . The C-CO-O-C stretching vibration of ester group was found at 1271.12 cm^{-1} . The C-C-O stretching vibration of alcohol group was observed at 1121.61 , 1072.13 cm^{-1} . According to the IR spectrum in Figure (4), the function groups present in the compound (4) are the hydroxyl group, sp^2 and sp^3 hydrocarbons, carbonyl group and ester functional group respectively.

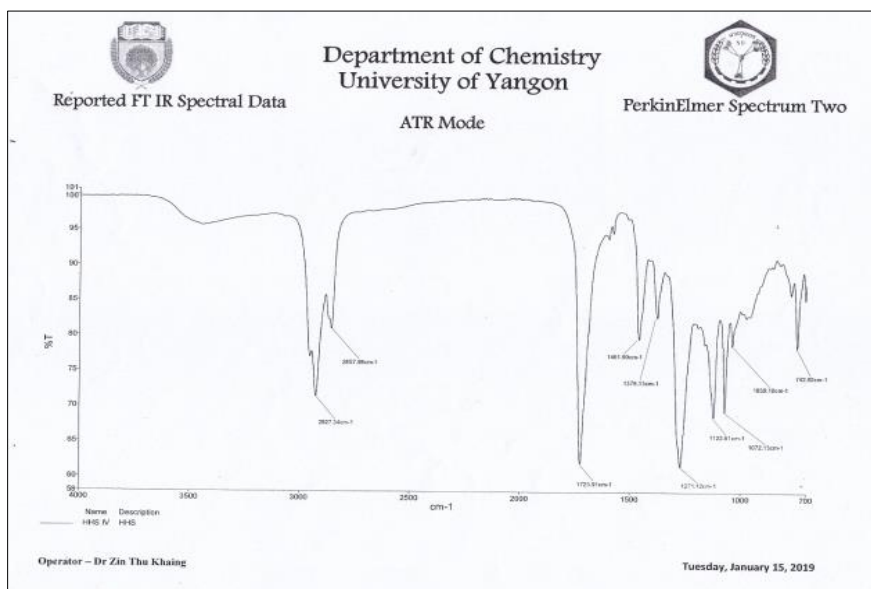


Fig 4:- FT- IR Spectrum of Compound (4)

F. Functional Group Determination of Compound (5)

From the figure (5), the peak at around 3040 cm^{-1} represents the C-H stretching vibration of sp^2 hydrocarbons. The peaks at 2927.57 and 2858.80 cm^{-1} indicate the asymmetric and symmetric C-H stretching vibrations of sp^3 hydrocarbons. The C=O stretching vibration of carbonyl group is found at 1724.15 cm^{-1} . The peak around 1600 cm^{-1} is due to the C=C stretching vibration of alkene group. The

band observed at 1462.02 cm^{-1} is due to the C-H in plane bending vibration of sp^3 hydrocarbons. The C-CO-O-C stretching vibration of ester group was found at 1270.52 cm^{-1} . The C-O-CO-C stretching vibration of ester group was observed at 1121.06 , 1071.91 cm^{-1} . According to the IR spectrum in Figure (5), the compound (5) contains the hydroxyl group, sp^2 and sp^3 hydrocarbons, carbonyl group and ether functional group.

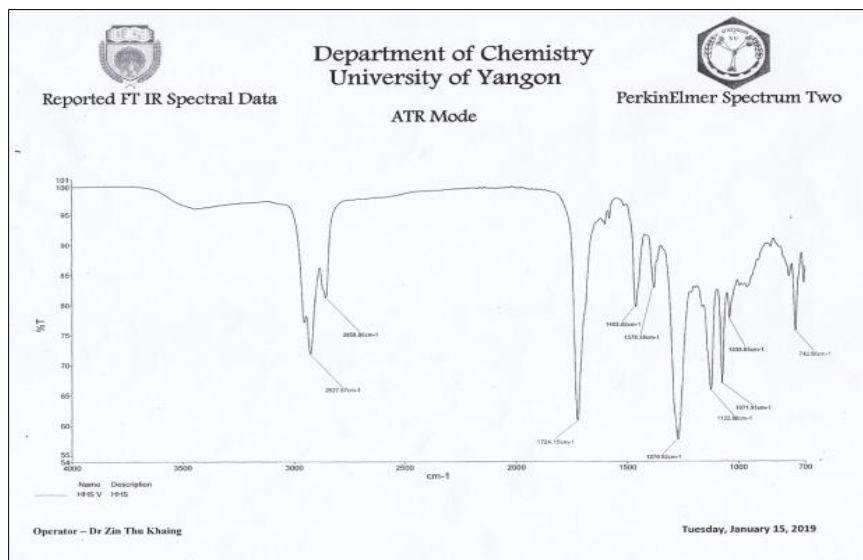


Fig 5:- FT- IR Spectrum of Compound (5)

IV. CONCLUSION

In this research, the roots of *Homonoia riparia* Lour were used to evaluate the phytochemical constituents, to isolate some organic compounds and to determine their functional groups by FT- IR spectral data. Phytochemical analysis of *H. riparia* (Kyauk-kant-nanthar) showed that terpenoids, phenolic compounds, reducing sugars, tannins, saponins, polyphenols, steroids, glycosides, and flavonoids are present. Five organic compounds (1- 5) were isolated using Thin Layer and Column Chromatographic separation methods. The compounds (1) and (3) were obtained as white crystal form while the others were isolated as pale yellow crystals. The weights of the isolated compounds (1- 5) were found as 12.8 mg, 7.9 mg, 10.5 mg, 9.3 mg and 29.1 mg respectively

The functional groups determinations of the compounds (1-5) were done by FT- IR analysis. The functional groups present in the compounds (1 - 5) were found as hydroxyl group, sp^2 hydrocarbons, sp^3 hydrocarbons, and carbonyl and ester functional groups respectively. The functional groups present in compounds (2, 4 and 5) are very similar from the comparison of the FT- IR spectral data of all isolated compounds.

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REFERENCES

- [1]. I. Lee, S. Jung, C. Kim and J.S. Kim, "Phenolic Compounds from the Leaves of *Homonoia raparia* and their Inhibitory Effects on Advanced Glycation End Product Formation", *Natural Product Sciences*, vol. 23, No. 4, pp.274- 280, 2017.
- [2]. S.K. Xavier, R.A. Devkar, S. Chaudhary, C.S. Shreedhara and M.M. Setty, "Pharmacognostical Standardisation and HPTLC Quantification of Gallic Acid in *Homonoia riparia* Lour.", *Pharmacognosy Journal*, vol. 7, No. 6, pp. 383- 388, 2015.
- [3]. L.T. Huyen, N.T. Son and P.V. Kiem, "Two Cycloartanes- type Triterpenoid from *Homonoia riparia* Lour", *Vietnam Journal of Chemistry, International Edition*, vol. 55, No. 4, pp. 494- 498, 2017.
- [4]. F. Xu, X. Zhao, L. Yang, X. Wang and J. Zhao, "A New Cycloartane-Type Triterpenoid Saponin Xanthine Oxidase Inhibitor from *Homonoia riparia* Lour", *Molecules*, vol. 19, pp. 13422- 13431, 2014.
- [5]. T. Li and L. Wang, "Riparsaponin Isolated from *Homonoia riparia* Lour Induces Apoptosis of Oral Cancer Cells", *Oncology Letters*, vol. 14, pp. 6841- 6846, 2017.
- [6]. V. Kabbinala, S.N. Prabhu, K.N.S. Kumar, N. Chandra, B. Ravishankar and B. Yashovarma, "Preleminary Phytochemical Examination of *Homonoia riparia* Lour. and its Effect on Clotting Tim in vitro", *The Journal of Phytopharmacology*, vol. 4, No. 3, pp. 172- 175, 2015.
- [7]. S.M. Yang, X.K. Liu, C. Qing, D.G. Wu and D.Y. Zhu, " Chemical Constituents from the Roots of *Homonoia riparia*", *Yao Xue Xue Bao*, vol. 42, No. 3, pp. 292- 296, 2007.
- [8]. I. Lee, J. Kim, Y.S. Kim, N.H. Yoo, C.S. Kim, K. Jo, J.H. Kim, T. T. Bach and J. S. Kim. "Cycloartane-Type Triterpenes from the Leaves of with VEGF- Induced Angiogenesis Inhibitory Activity ", *Journal of Natural Products*, vol. 75, No. 7, pp. 1312- 1318, 2012.
- [9]. J.B. Harbone, "Phytochemical Methods: A guide to modern techniques of plant analysis", Chapman and Hall, New York, 279, 1993
- [10]. P. Crews, J. Rodriguez and M. Jaspars, "Organic Structure Analysis", New York, Oxford University Press, 1998.