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Phytochemical, Spectral Analysis of Greenhouse Solar Dried Medicinal Plants (Moringa oleifera,Trigonella foenum-graecum)

A.N.Seethalashmi[1], C.Veerakalyanamunnadi [2]
[1] Assistant professor, [2] Research Scholar
[1,2] Department of Physics, The M.D.T Hindu College, Tirunelveli

Abstract: - The main objective of this study is to develop a solar greenhouse dryer which may result in considerable reduction of drying time and to preserve the quality of the medicinal plants (Moringa oleifera, Trigonella foenum-graecum). Qualitative and quantitative phytochemical analysis (greenhouse solar dried and shadow dried) were carried out for the selected medicinal plants. The qualitative estimations were done in triplicates and the mean values are taken. Secondary metabolites like Tannins, alkaloids, flavonoids, saponins, aromatic acid, protein, steroid, triterphenoid, catachicin, anthroquinones, sugar and reduced sugar are dominantly reported in all chosen plants. In quantitative estimations, biochemical and physiological studies were carried out for carbohydrates, proteins, phenols and lipids using standard method of analysis. Spectral analysis was carried out to confirm the presence of phytochemicals. Through on an experimental basis, the exercise has made it clear that the greenhouse solar dryer is a promising appliance since it is based on renewable energy and with effective marketing can be used for various drying purposes.

Keywords: Greenhouse solar drier, Moringa oleifera, Phytochemical analysis, Trigonella foenum-graecum.

INTRODUCTION

Energy is important for the existence and development of human kind and is a key issue in developing countries. To reduce the impact of conventional energy sources on the environment, it is must to explore new and renewable energy resources. Solar energy is environment friendly, renewable and sustainable. Though it is seasonal with geographical dependence, exploring higher efficiency solar energy concentration technology is necessary and realistic [1]. Drying agricultural products using renewable energy such as solar energy is environmental friendly and has less environmental impact. Medicinal plants have played a key role in world health. They are distributed worldwide, but they are most abundant in tropical regions. It is estimated that about high 25% of all modern medicines are directly or indirectly derived from higher plants [2]. In this present work we made an attempt to study qualitative and quantitative phytochemical properties of medicinal plants Moringa oleifera (Moringaceae family) and Trigonella foenum-graecum (fabaceae family) which are dried in the constructed greenhouse solar dryer. In the international markets the need of plant based drugs are increased because of high effectiveness, negligible toxicity and it may be a good substitute for allopathic medicine. [3]. Moringa oleifera is easily available and is a sustainable remedy for malnutrition [4]. Moringa is rich in vitamin c, protein and potassium [5]. Trigonella foenum-graecum is also rich in vitamin c, calcium, and β carotene [6]. To detect bioactive constituents, spectroscopy (UV-visible & FTIR) methods are carried out [7]-[9]. UV-visible is used to compute the functional groups present in the medicinal plants by comparing it with standards [10]. To identify the bioactive chemical constituent and to reveal the compound structure FT-IR high resolution technique is used [11], [12].

The main objective of this study is to dry the selected medicinal plants using constructed greenhouse solar dryer which may result in considerable reduction of drying time and may preserve the quality of the plants by analyzing the preliminary biochemical and secondary metabolites (flavonoids, alkaloids, tannin etc.,).

II. MATERIALS AND METHODS

Green house solar dryer (Fig.1) was constructed using polycarbonate sheet (Double walled UV protect sheet) of thickness 6mm. The polycarbonate sheet can be used as the glazing material for the collector area which is responsible for filtering UV radiation and may cause degradation of vitamins, color and flavor in the samples.

Fig.1. Green house solar drier

The medicinal plants Moringa oleifera and Trigonella foenum-graecum (Fig.2) were dried in the greenhouse solar drier for one day (9 am to 4 pm).Similarly they were also dried at room temperature for a period of four days to seven days depending on the water content. The completely dried materials (both shadow and greenhouse solar dried) were separately powdered by means bearing blunder and powder was extracted with ethanol method. Dried extract was used for phytochemical screening [13], [14]. The Ultraviolet-Visible spectroscopy of ethanolic extract (Fig.3) of the selected plants Moringa oleifera and Trigonella foenum-graecum was subjected to 200-1100 nm. The FT-IR studies were done to determine the functional groups present in the ethanolic extract of the selected plants.

Fig.2. Medicinal Plants Moringa oleifera and Trigonella foenum-graecum

Fig.3. Medicinal Plants extracts of Moringa oleifera and Trigonella foenum-graecum (soxhelt method)

III. RESULTS AND DISCUSSION

Preliminary qualitative test is useful in the detection of bioactive principles and it may lead to drug discovery and development [15]. The biochemical screening of Moringa oleifera and Trigonella foenum-graecum are presented in Table I.

Table.I. Phytochemicals in Moringa oleifera and Trigonella foenum -graecum (for both shadow and greenhouse solar dried samples)

S.No	Extract	Saponins	Tannin	Alkaloids	Flavanoids	Amino Acids	Phenols	Protein	Steroid	Triterpenoid	Catechiein	Anthroquinone	Sugar	Reduced Sugar	Aromatic Acid
1	1a	+	+	+	+	+	+	+	+	+	+	+	+	+	-
2	1b	+	+	+	+	+	+	+	+	+	+	+	+	+	-
3	2a	+	+	+	+	+	+	+	+	+	+	+	+	+	-
4	2b	+	+	+	+	+	+	+	+	+	+	+	+	+	-

1a. Moringa oleifera shadow dried extract
1b. Moringa oleifera greenhouse solar dried extract
2a.Trigonella foenum-graecum shadow dried extract
2b.Trigonella foenum-graecum green house solar dried extract

[16]Reported that the medicinal plants which have tanninsand flavonoids can possess significant pharmacological activities. Plants which are rich in saponins have immunity boosting and anti-inflammatory properties [17]. Due to the presence of tannins, alkaloids, saponins, flavonoids and steroids the medicinal plants have anti-dysenteric and anti-diarrheal properties [18] - [19].

Biochemical studies were carried out for carbohydrates, proteins, phenols and lipids. The quantitative analysis is listed in Table.II. The secondary metabolites carbohydrates (2.76 mg/gm.dw,2.92 mg/gm.dw) and proteins (1.54 mg/gm.dw, 1.73 mg/gm.dw) are little bit increasedin solar dried medicinal extract than the shadow dried. Lipids and phenols are retained as same for both shadow and solar greenhouse dried samples.

Table.II. Quantitative estimation of biochemical constituents of Moringa oleifera and Trigonella foenum-graecum (both shadow and greenhouse solar dried samples)

Sample	Carbohy-drates mg/gm.dw	Proteins mg/gm.dw	Lipid mg/gm.dw	Phenol mg/gm.dw

1a	2.12	1.52	0.85	0.18
1b	2.76	1.54	0.85	0.18
2a	2.42	1.49	0.27	0.21
2b	2.92	1.73	0.32	0.21

1a. Moringa oleifera shadow dried
1b. Moringa oleifera greenhouse solar dried
2a.Trigonella foenum-graecum shadow dried
2b.Trigonella foenum-graecum green house solar dried.

Ultraviolet and visible spectrum (Fig.4a, 4b, 5a, 5b) of leaf extracts (both shadow and solar dried) of selected medicinal plants Moringa oleifera and Trigonella foenum-graecum have absorption in the range of at 200 to 400 nm. It indicates the presence heteroatoms S, N, O [20]. The spectrum also shows the peaks at 331 nm, 410 nm (Moringa oleifera solar and shadow dried) and 356 nm, 331 nm (Trigonella foenum-graecum solar and shadow dried) which confirms the presence of organic chromopores.

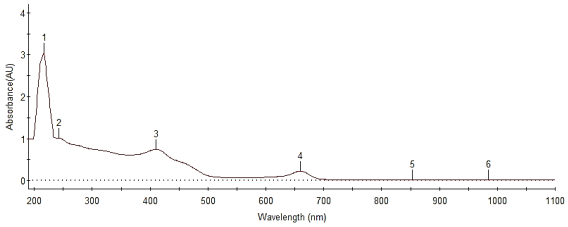

Fig.4a. UV and visible spectrum of Moringa oleifera (shadow dried)

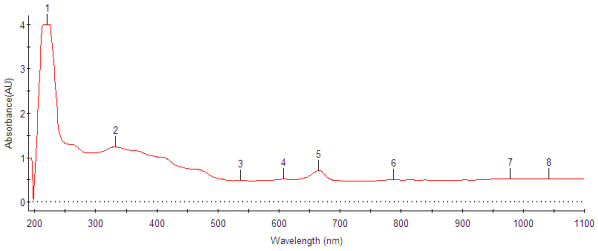

Fig.4b. UV and visible spectrum of Moringa oleifera (solar dried)

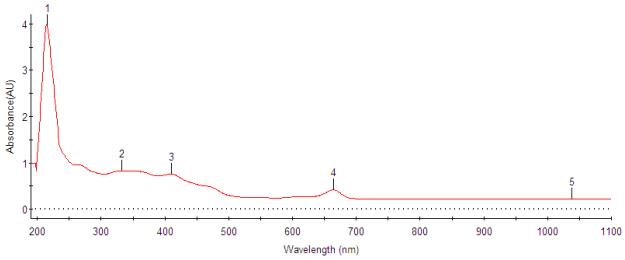

Fig.5a. UV and visible spectrum of Trigonella foenum-graecum (shadow dried)

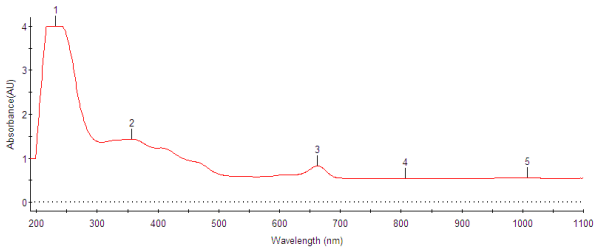

Fig.5b. UV and visible spectrum of Trigonella foenum-graecum (solar dried)

FTIR- analysis of the leaf extracts of selected medicinal plants' absorption bands and the wave numbers (cm-1) of the prominent peaks are described in (Table.III, IV& Fig.6a, 6b, 7a, and 7b)

Table.III. FT-IR spectral assignments for Moringa oleifera (solar and shadow dried)

Wave Number Cm^{-1}		Assignments	References
Solar dried	**Shadow dried**		
3402	3420	O-H Stretch	[24]
2927	2924	O-H Stretch Carboxylic acids	[24]
2855	2854	C-H stretch Alkyl	[24]
2101	2092	C=C stretch Alkynyl	[24]
1652	1631	C=O Stretching	[24]
1384	1384	C-N Stretch	[25]
1325	1320	C=H bending	[24]
1247	1244	G-ring plus C=O stretch in lignin	[25]
1101	1102	C-O Stretching	[26]
1072	1067	C=O Stretch	[24],[26]

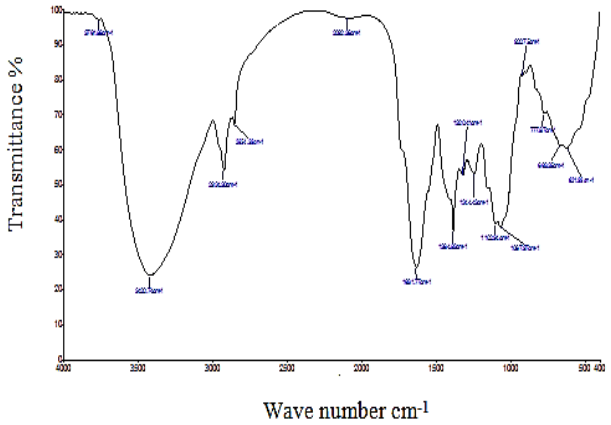

Fig.6a. FT-IR Spectrum of Moringa oleifera (shadow dried)

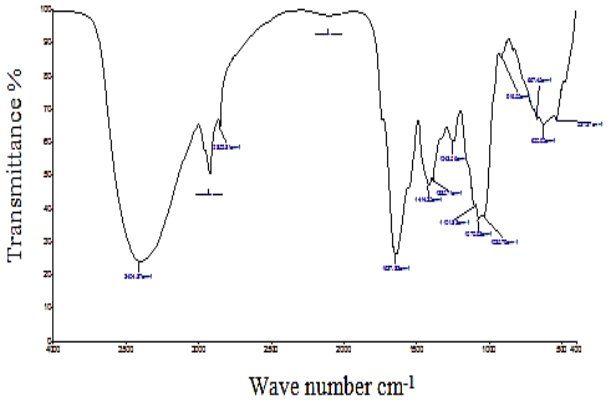

Fig.7b. FT-IR Spectrum of Trigonella foenum-graecum (solar dried)

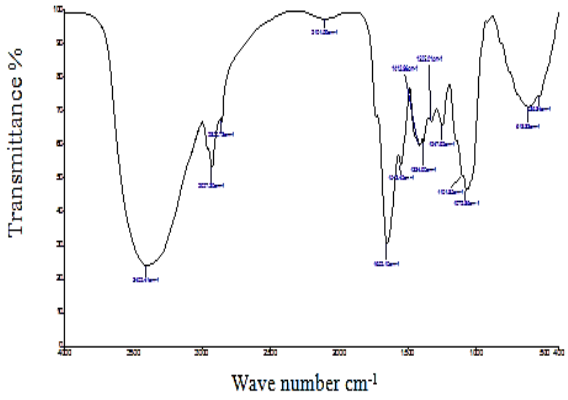

Fig.6b. FT-IR Spectrum of Moringa oleifera (solar dried)

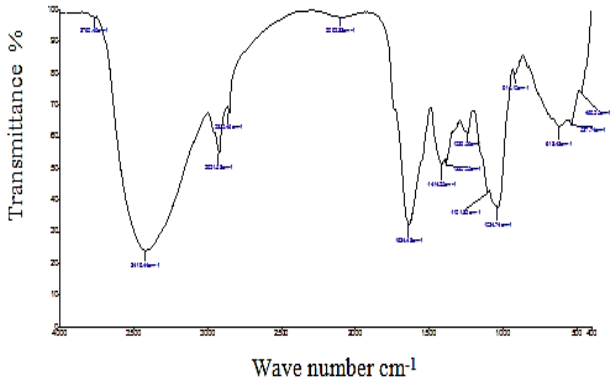

Fig.7a. FT-IR Spectrum of Trigonella foenum-graecum (shadow dried)

Table.IV. FT-IR spectral assignments for Trigonella foenum-graecum
(solar and shadow dried)

Wave Number Cm^{-1}		Assignments	References
Solar dried	**Shadow dried**		
3404	3419	O-H Stretch	[24]
2933	2921	O-H Stretch Carboxylic acids	[24]
2952	2852	C-H stretch Alkyl	[24]
2087	2092	C=C stretch Alkynyl	[24]
1637	1634	C=O Stretching	[24]
1414	1414	CH_2 scissor vibration and CH_3 bending vibration	[24],[26]
1385	1385	C-N Stretch	[25]
1243	1239	G-ring plus C=O stretch in lignin	[25]
1070	1032	C-O Stretching	[26]

The peaks at 3402 cm^{-1},3420 cm^{-1}(*Moringa oleifera* solar and shadow dried) and3404 cm^{-1}, 3419 cm^{-1}(*Trigonella foenum-graecum* solar and shadow dried) revealed the presence of alcohols, phenols. The peaks at 2927 cm^{-1}, 2924cm^{-1} (*Moringa oleifera* solar and shadow dried) and 2933 cm^{-1}, 2921cm^{-1}(*Trigonella foenum-graecum* solar and shadow dried) confirm the presence of alkanes. The peaks at 1652 cm^{-1}, 1631 cm^{-1} and 1637 cm^{-1} 1634 cm^{-1} correspond to the carboxylic acid group. The presence of aromatic amine is confirmed by the prominent peaks at 1384 cm^{-1} and 1385 cm^{-1}.Prominent peaks at1247 cm^{-1}, 1244 $cm^{-1}$and 1072 cm^{-1},1067 cm^{-1}(*Moringa oleifera* solar and shadow dried) and 1243 cm^{-1}, 1239 cm^{-1} and1070 cm^{-1}, 1034 cm^{-1} (*Trigonella foenum-graecum* solar and shadow dried) confirm the presence of alcohols, carboxylic acids and esters [20].

The fluorescence spectra of (Moringa oleifera and Trigonella foenum-graecum) green leaf extract are presented in (Fig.8a, 8b, 9a, 9b). There are three main areas of fluorescence bounded by 380 nm - 550 nm, 650 – 700 nm and 700-750 nm (Moringa oleifera shadow and solar dried, Trigonella foenum-graecum shadow and solar dried). The areas bounded by 380 – 550 nm, 650 – 750 nm would be blue green fluorescence and red fluorescence respectively. The red and near infrared fluorescence are from chloroplasts (Chlorophyll). The blue green is from the aromatic compounds, polyphenols and alkaloids [21].The chlorophyll to polyphenol ratio is the factor which determines the forecasts of agronomy through prognosis on the need for nitrogen fertilization[22]. This sort of measurement gives the information of stress disturbing plants "for photo synthetic activity" [23].

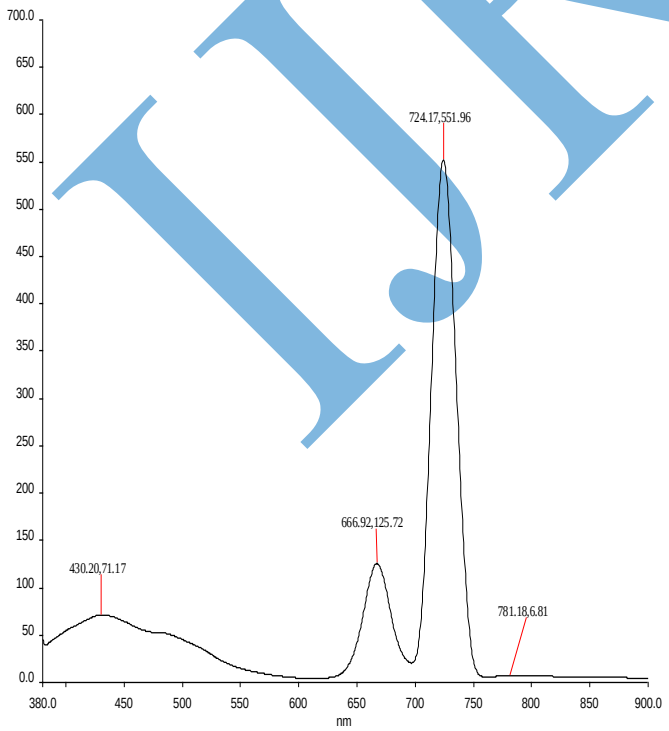

Fig.8a. Fluroscence spectra of Moringa oleifera (shadow dried)

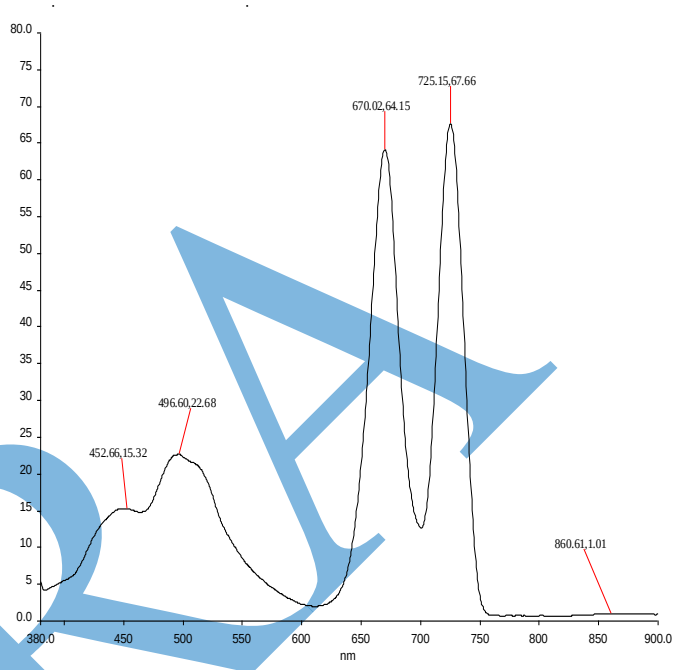

Fig.8b. Fluroscence spectra of Moringa oleifera (solar dried)

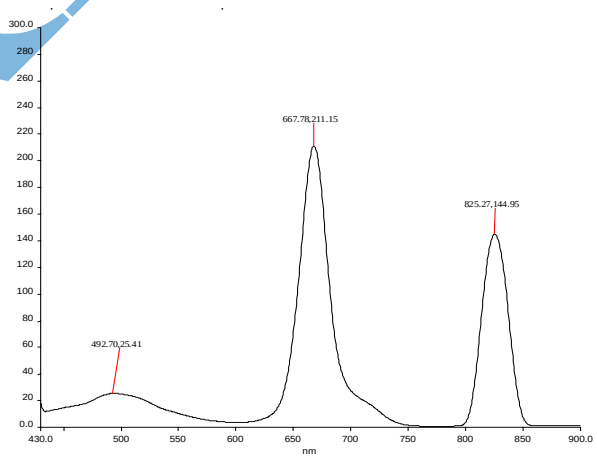

Fig.9a. Fluroscence spectra of Trigonella foenum-graecum (shadow dried)

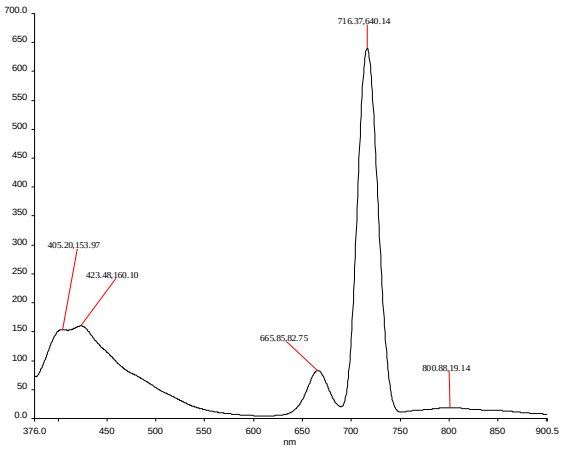

Fig.9b. Fluroscence spectra of Trigonella foenum-graecum (solar dried)

IV. CONCLUSION

Drying process play an important role in the preservation of medicinal products. The constructed green house solar drier leads to considerable reduction of drying time in comparison to shadow drying. The quality of the selected medicinal plants dried in the green house solar drier is of quality of the shadow dried medicinal plants. The colour of the samples dried in the green house drier is better than the shadow dried. The preliminary phytochemical analysis, biochemical studies and spectral analysis reveals that the greenhouse solar drier is a promising appliance. Since it is based on renewable energy and with effective marketing can be used for various drying process.

REFERENCE

[1] W.T.Xie, Y.J. Dai, R.Z. Wang, K. Sumathy, "Concentrated solar energy applications using Fresnel lenses: A review Renewable & Sustainable Energy Reviews," Vol. 15(6), pp. 2588 – 2606,2011.

[2] JB. Calixto, "Efficacy, Safety, Quality control, Marketing and Regulatory Guidelines for Herbal Medicines (PhytotherapeuticAgenets). Braz. J. Med. Biol. Res," 33(2): 179-189, 2000.

[3] G. Ashis,"Herbal folk remedies of Bankura and medinipur districts, west Bengal," Indian Journal of Traditional knowledge,2(4), 393-6, 2003.

[4] J.N. Kasolo, G.S. Bimenya, L. Ojok, J. Ochieng, J.W. Ogwalokeng, "phytochemicals and uses of Moringaoleifera leaves in Ugandan rural communities," J. Med, Plants Res. 4: 753-757, 2010.

[5] J.L. Rockwood, B.G. Anderson, D.A. Casamatta, "Potential uses of Moringaoleifera and an examination of antibiotic efficacy conferred by M. oleiferaseed and leaf extracts using crude extraction techniques available to under-served indigenous populations," Int. J. Phytothearpy Res. 3: 61–71, 2013.

[6] K. Srinivasan, "Fenugreek (Trigonellafoenum-graecum): A Review of Health Beneficial Physiological Effects," Food Reviews International 22: 203- 224, 2006.

[7] DC. Liebler, Ja. Burr, L. Philips, A. Ham,"Gas chromatography. Mass spectrometry analysis of vitamin E and its oxidation products," Analytical Biochemistry, 236(1): 27-34, 1996.

[8] P. Aysal, AD. Ambrus, SJ. Lenotay, A. Cannavan,"Validation of an efficient method for the determination of pesticide residues in fruits and vegetables using ethyl acetate for extraction,"J. Environ Sci. Heal, 42: 481-90, 2007.

[9] M. Ibrahim, AJ. Hameed, A. Jalbout,"Molecular spectroscopic study of River Nile Sediment in the Greater cairo Region," Applied spectroscopy 62(3), 306-11, 2008.

[10] Vijayarekha P, Sengottaiyan N. Phytochemical Evaluation, Antibacterial Activity and Bioactive Determination Indian Journal of science and Technology.9(5) 1-6, 2016.

[11] A. Hashimoto, T. Kameoka,"Applications of infrared spectroscopy to biochemical, food and agricultural processes," Applied Spectroscopy Reviews 43: 416-51,2008.

[12] K. Hussain,Z. Ismail, A. Sadikun, P. Ibrahim,"Evaluation of Metabolic changes in fruit of piper armentosum in various seasons by metabolomics using Fourier Transform Infrared (FTIR) Spectroscopy," International Journal of Pharmaceutical and Clinical Research 1(2): 68-71, 2009.

[13] M. Kalakoti, A. Kumar, "Phytochemical screening of leaf extract of Meiztropispellita (Patwa): An Endangered plant species," International Journal of Advance Research 3(4): 361-5, 2015.

[14] GL. Silva, L. Lee, K. Dougles,"Special problems with the extraction of plants Natural Products Isolation," 4:343-63, 1998.

[15] N. Savithramma, P. Venkateswarlu, D. Suhrulatha, S.K.M. Basha, C.H. Venkataramanadevi, "The Biosc,"5: 359-362, 2010.

[16] A. Ahmadiani, J. Hosseiny, S. Semnanian, M. Javan, F. Saeedi, M. Kamalinejad, S. Saremi,"Anti-nociceptive and Anti-inflammatory Effects of Eleagnusangustifolia Fruit Extract," J Ethnopharmacol, 72:287–292, 2000.

[17] D.Kenner, Y. Requena, "Botanical medicine: a European professional perspective,"books.google.com, 2001.

[18] J. Galvez, A. Zarzuelo, M.E. Crespo, M.D.Lorente, M.A. Ocets,J. Jimenez, "Anti-diarrheal activity of Euphorbia hirtaextract and isolation of an active flavonoid constituent,"PlantaMedica,59: 333 – 336, 1993.

[19] O.A. Loganga, A. Vercruysse, and A. Foriers,"A Contribution to the ethanobotanical, phytochemical PhytochemistryoftheFamilyand pharmacology studies of traditionally usedmedicinal plant in the treatment of dysentery and diarrhoeal in Lomela area," Democratic Republic ofCongo (DRC)J. Ethnopharmacol.71(3): 41-423,2000.

[20] D.I. Njoku, M.A. Chidiebere, K.L. Oguzie, C.E.Ogukwe, E.E.Oguzie, "Advances in Materials and Corrosion,"Volume 1, Pages 54-61 "Corrosion inhibition of mild steel in hydrochloric acid solution by the leaf extract of Nicotianatabacum," 2013.

[21] Z.G. Cerovic, G. Samson, F. Morales, N. Tremblay, I. Hoya, "Ultraviolet - Induced fluorescence for plant monitoring; present state and prospects. Agronomie," Agriculture and Enviornment. 19, 543-578, 1999.

[22] A. Cartelat, Z.G. Cerovic, Y. Goulas, S. Meyer, C. Lelarge, J.L.Prioul, A. Barbottin, M.H. Jeuffory,P. Gate, U. Agati, I. Moya, "Optically assessed contents of leaf polyphenolics and chlorophyll as indicators of nitrogen deficiency in wheat (Triticumaestivuml) field crops research" 91; 35-49, 2005.

[23] H.M. Kalaji, A. Jajoo, A. Oukarroum, M. Brestic, M.Zivcak, I.A. Samborska, M.D. Center, I. Lukasik, V. Goltsev, R.J. Ladle, P. Dabrowski, and P. Ahmad, "The use of chlorophyll fluorescence kinetics analysis to study the performace of photosynthetic machinery in plants," P. Ahmad (Ed)"Emerging Technologies and Management of crop stress Tolerance, (2) Chapter 15: The use of chlorophyll fluorescence kinetics analysis," 347-384 DOI: http://dx.doiorg/10.1016/B978-0-12-800875-1.00015-6

[24] O. Faix, "Classification of ligning from different botanical origin by FTIR spectroscopy. Holzforschung," 45:21-27, 1991.

[25] O. Faix, "Determination of hydroxyl groups in lignins evaluation of 1H-, 13C-, 31P-NMR, FTIR and wet chemical methods,"1994

[26] K.J.Harrington, HG. Higgins, AJ. Michell, "Infraredspectra of Eucalyptus regnans," F. Muell and pinusradiataD.DonHolzforschung, 1964, 18, 108-113.

