WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Physicochemical Investigation and Phytochemicals Screening of Karanj Leaves (Milletia Pinnata L.)

Vandna Pathak*[1] and Lalita Raikwar *[2]

[1]Associate Professor, Faculty of Science and Environment, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot Satna Madhya Pradesh, India

[2]M.Sc. (IC) IV. Semester, Department of Physical Sciences, Faculty of Science and Environment, Mahatma Gandhi Chitrakoot Gramodaya Vishvavidhyalay.

ABSTRACT :

The Present paper deals with the "Physicochemical investigation and phytochemicals screening of karanj leaves (milletia pinnata L.) "The results which were obtained showed the presence of various Phytochemicals viz. Alkaloids, Tannins, Resins, Phenols, Carbohydrates, Cardiac Glycosides, Proteins etc. The detailed discussion is given in the paper.

Keywords : *Milletia pinnata, Physicochemical, Phytochemical, Alkaloids, carbohydrates, Proteins.*

Introduction:-

Medicinal plants play an important role in human lives for many years to Treat various diseases all over the world. Plants are the diverse producer of Bioactive compounds that make them a rich source of different types of medicines[1]. Today, there is widespread interest in drugs obtained from natural plants for Their various therapeutic properties. Pongamia pinnata Linn Pierre (Fabaceae) is a Fast-growing medium-sized tree that belongs to the Leguminosae family [2].It is an important non-edible minor oilseed tree. It is also called as "Karum Tree" or "Poonga Oil Tree" in English [3]. It is native mainly to hot arid regions of Asia. The trees Pongamia are cultivated commercially in India. It Includes various chemical compounds such as alkaloids, flavonoids, tannins, glycosides, hormones, karangin, glabrin, kanugin, fixed oils, and others [4] that possess various potential anti-inflammatory, anti-nociceptive, antioxidant, anti-diarrheal, anti-fungal, anti-plasmodial, anti-ulcer, anti-hyperglycemic, anti-oxidative, anti-hyperammonemic, and analgesic functions [5,6]. All parts of the plant P. pinnata have been considered as a crude drug [7]. The traditional use of Millettia species includes antibacterial, anti-tumour, insecticidal, pesticidal, piscicidal antispasmodial, chemopreventive joint pain, rheumatoid arthritis, amenorrhea, tuberculosis, etc. Most of them are used in the production of biodiesel [8,9]The tree Is known for its Multipurpose advantages and as a potential biodiesel source. On average, the seeds are stated to contain around 28-34% Oil with a high percentage of polyunsaturated fatty acids.[10].

Classification:-

Kingdom	**Plantae**
Order	**Fabales**
Family	**Fabaceae**
Subfamily	**Faboideae**
Genus	***Milletia***
Species	***m. Pinnata***

(A)

(B)

- ***medicinal use:-**
- Milletia pinnata has laxative properties that can help clear the stomach.
- It is used for the treatment of piles as well as for bleeding disorders.
- The leaf juice us meant for the treatment of cough, colds, leprosy, diarrhoea.
- It is used for the treatment of abdominal ulcers, tumor.
- It has antibacterial and anti-inflammation properties
- Roots and bark of milletia pinnata are used extremefor joint pain.
- Material and method

Materials which were used in the study are given in the table: 1

The list of glassware, instrument, regents and chemicals which were used in the study are given in table-1

Glass ware	**Instrument**	**Regent**
Conical flask	Water bath	Lead acetone solution
Funnel	Weighting machine	Benedict solution
Glass rod	Hot air oven	Dragendroff's reagent
Petri dish	Heating mental	Hager's reagent
Pipette	Brush	Wagner’s reagent
measuring calendar	Desiccators	Molish's reagent
Iodine flask	Filter paper	Cuso4. 5H2o
Test tube	Mixer grinder	Fecl3 solution
Dropper	Spatula	Nahco3
Beaker	Sleave	Distilled Water
Crucible	Tray dryer	Hydrochloric acid
Reagent bottle	Grinder machine	Feric chloride
Capillary tube	Reprostar	Methanol
China dish	HPTLC	Folin’s reagent
Pipettes	Linomat	Acetone

Sample collection :-The whole plant of milletia pinnata was collected from Arogyadham Ayurved Sadan chitrakoot, satna [M.P].Taxonomical identification and authentication of milletia pinnata plant were done by Dr.Manoj Tripathi department of Ayurveda Sadan Arogyadham.Plant were washed throughly in running water to remove soil and running foreign particles. These were cut into small pieces dried in shade. Shade dried plant sample were powered using grinder and was stored in air tight container for further chemical analysis. The parameters which were analyzed in the present study are:

The parameters which were analysed are :-

[1] Physicochemical Analysis:-

1. LOD (Lose on drying at 105°C,

- Extractive value:-

2. Water Extractive value
3. Methanol extractive value
4. Ethanol Extractive value
5. Benzene extractive value
6. Acetone extractive value.

[2]. Ash value

1. **Total ash**
2. **.Acid insoluble ash**

[3]. phytochemical analysis:-

1. Test for alkaloids
2. Test for flavonoids
3. Test for tannins
4. Test for resins
5. .Test for carbohydrate
6. Test for proteins
7. .Test for saponins
8. .Test for cardiac Glycosides

[4]. High performance Thin Layer Chromatography (HPTLC) Fingerprint profile:-

1. **Determination of Moisture Content (Loss on drying at 105°C)**

2gm of sample powder was transferred to weighed thin porcelain dish and kept in oven at 105°C for 5 hours. Dish was cooled in desiccators and weighed. The dish again kept in oven for 30 minute. Dish again cooled in desiccator and take weight. The loss in weight is calculated as percentage.

*****Extractive value

1 Determination of water soluble extractive

Weighed accurate 2g powder sample and transferred in 250 ml Iodine flask. Add 100ml water solvent. Provide continuous shaking for 6 hrs and leave for 18 hrs (maceration) After this extract was filtered by using what man filter paper no. 1 and weighted in thin orcelain dish, solvent was evaporated on water bath and residue was weighed. Percentage of extractive value (w/w) was determined

2.Determination of methanol soluble extractive

Weighed accurate 2gm powder sample and transfer in 250 ml Iodine flask. Add 100ml alcohol solvent. Provide continuous shaking for 6 hrs and leave for 18 hrs (maceration). After this extract was filtered by using what man filter paper no. 1 and weighted in thin orcelain dish, solvent was evaporated on water bath and residue was weighed. Percentage of extractive value (w/w) was determined.

3.Determination of ethanol Extractive value :-

Weighed accurate 2gm powder sample and transfer in 250 ml Iodine flask. Add 100ml ethanol solvent. Provide continuous shaking for 6 hrs and leave for 18 hrs (maceration). After this extract was filtered by using what man filter paper no. 1 and weighted in thin orcelain dish, solvent was evaporated on water bath and residue was weighed. Percentage of extractive value (w/w) was determined.

4.determination of Benzene extractive value :-

Weighed accurate 2gm powder sample and transfer in 250 ml Iodine flask. Add 100ml benzene solvent. Provide continuous shaking for 6 hrs and leave for 18 hrs (maceration). After this extract was filtered by using what man filter paper no. 1 and weighted in thin orcelain dish, solvent was evaporated on water bath and residue was weighed. Percentage of extractive value (w/w) was determined.

5.Determination of Acetone Extractive value:-

Weighed accurate 2gm powder sample and transfer in 250 ml Iodine flask. Add 100ml acetone solvent. Provide continuous shaking for 6 hrs and leave for 18 hrs (maceration). After this extract was filtered by using what man filter paper no. 1 and weighted in thin orcelain dish, solvent was evaporated on water bath and residue was weighed. Percentage of extractive value (w/w) was determined.

***Determination of Ash values**

The ash value is useful to determine the quality and purity of the drug. Ash contains Inorganic radicals like phosphate, carbonates and silicates of sodium, potassium, agnesium, Calcium, etc. Different ash values such as total ash value and acid insoluble ash value was Determined.

1.Determination of total ash:-

2 gm accurately weighed of the ground drug in a tared platinum or silica dish (previouslyWeighed). Material was incinerated with the help of the muffle furnace at 450OC, until Vapors almost cease to evolve. Dish was heated until all carbon was burnt off. Dish was Cooled, and calculated the percentage of ash value with reference to the air dried drug.

2.Determination of Acid-insoluble ash :-

Ash was boiled with 25 ml 5% hydrochloric acid for 5 minutes. Insoluble matter was collected in the ash less filter paper no. 42. It was washed with the hot water until Eutralize and ignite to constant weight, cooled in a desiccators and weighted. Calculate the percentage of acid insoluble ash with reference to the air dried drug.

***Phytochemicals analysis:-**

Preliminary phyto-chemical tests were carried out on ethanolic and water extract for the Presence\absence of phyto-constituents like alkaloids, flavonoids, tannins, resins, Carbohydrates, proteins and saponins.

***Test for Alkaloids**

Mayer's test: Add few drops of Mayer's reagents to 1 ml of the acidic, aqueous extract of the Drug. White or pale yellow colour is formed.

- **Wagner's Test:**Acidify 1 ml of the alcoholic extract with 1.5% v/v of HCl and few drops of Wagner's reagent. A yellow or brown ppt. is formed.
- **Test for Carbohydrate**

Benedict's test: To 0.5 ml of aqueous extract of drug, add 5 ml of Benedict's solution and boil for 5 minutes. Formation of coloured ppt. is due to presence of carbohydrates.

- **Fehling's test:** To 2 ml of aqueous extract of drug, add 1 ml of mix. Of equal parts of Fehling's solution A and Fehling's solution B and boil the content of the test tube for few minutes. A red or brick red ppt. is formed.
- **Test for resins**

Dissolve the 1 ml of extract in 1 ml of acetone and pour the solution into 5 ml distil water. Turbidity indicates the presence of resins.

- **Test for saponins**

In test tube containing about 5 ml of an aq. Extract of drug, add drops of sodium bicarbonate. Shake it vigorously and left for few minutes. Honey comb – like structure is formed.

- **Test for flavonoids**

In the test tube containing 0.5 ml of lcoholic extract of drug, add 5-10 drops of dil. HCl followed by small piece of 'Mg'. In the presence of flavonoids, pink, reddish pink or brown colour is produced.

- **Test for tannins**

To 1 – 2 ml of extract of drug, add few drops of 5% FeCl3 solutions. A greenish colour Indicate the presence of gallacto tannins while brown colour tannins.

*High Performance Thin Layer Chromatography (HPTLC) fingerprint profile

Development of HPTLC Fingerprint: High performance thin layer chromatography is automated form of TLC techniques.this method is used for separation of components present in the mixture. Both quantitatively as well as qualitatively. HPTLC of the Test solution Of all sample were carried out on Silica Gel 60F254. Pre coated plates (0.2mm thickness, from merck India Limited Mumbai).A TLC Applicator from Camag Linomat-5 (Camag Switzerland) was used for documentation unit (Camag reprostar -3)was used for documentation of chromatographic fingerprints.

Preparation of Test solution: Extract was prepared by taking 5g of sample powder and mixed it with 25 ml methanol and kept on worm water bath for 30 min and filtered and the filtrate was used for HPTLC.

Procedure: Applied 7 µL Each of the Test solution at 8 mm band and develop the plate in a solvent system **Toluene: ethylacetate: Formic acid** (7.0:3.0:0.5) to a distance of 9 cm dry the developed plate in air and examine under Ultraviolet light at (254 nm) and at 366 NM before derivatization.

Derivatization: Possibility of derivatization is a strong point ofHPTLC.Chemical reaction are possible on given plate before or after chromatography both the Possibility have their advantages. However the decision depends on sample matrix level of detection and interference present. Post Chromatography derivatization is more popular technique for which several for which several Hundred references in literature are available as compared to a few pre Chromatographic derivatization .The result's are unique and specific when before Chromatographic development has been recommended. Derivatiz the plate using methanol reagent and heating at 105°c till the bands are clearly visible and examined the plate. The Rf value and colour of band resolved were recorded.

***preparation of HPTLC**

- **Test solution :-** concentrated solution of with methanol.
- **Stationary phase :-** pre coated plates with silica gel 60f254 of 0.2mm Thickness.

7. Mobile phase :- Toleune , Ethylacetate, Formic acid (7.0:3.0:.0.5)

8. Volume of test sample Applied :- 7 ul

9. **Spray reagent :** 5**%** Methanolic H2So4

10. Distance travelled by solvent system :- 8.9cm.

11. **Developed chamber** :- twin through chamber (10×10) cm.

- Results & Discussion

The parameters which were analysed in the study are :-

1. Loss on drying (LOD)

- **Extractive value**

2. Water extractive value
3. Ethanol extractive value
4. Methanol extractive value
5. Benzene extractive value
6. extractive value.

- **Ash value**

7. Total ash
8. Acid insoluble

- **Phytochemicals**

9. Alkaloids

10. Flavonoids

11. Saponins

12. Tannins

13. Resin

14. Carbohydrates

15. Phenol

16. Test for cardiac Glycosides

17. Protein test .

- High Performance Thin Layer Chromatography (HPTLC) Fingerprint profile.

And the results are tabulated below from table number 1-8 table.

1.Table No:- 1 Loss On Drying (LOD value of karanj leaves)

Sr.No.	Weight of the petridish with sample	Weight of the petridish Sample 1st reading	After ½ hours drying wt. (2nd reading)	Difference
1.	31.8957	31.7942	31.7896	0.1061
2.	39.1819	39.0770	39.0704	0.1115

1.1st Sample weight -2g

- Average 1st weight difference =0.1061
- LOD % = 0.1061×100/2
- LOD% = 5.08%

2.2nd time sample

- Average 2nd weight difference= 0.1115
- LOD% = 0.1115× 100/2
- LOD% = 5.575%

2. Water soluble extractive value of millettia pinnata (karanj):-

Sr. No.	**Weightof petridish (A)**	**Weight of petridish with sample (B)**	**Difference (A-B)**
a)	37.9725	38.0157	0.0432
b)	38.0011	38.0412	0.0401

Sample (a) Extractive value:-

- Sample weight = 2 g
- Average weight difference = 0.0432
- Extractive value = 0.0432 × 500
- Extractive value = 21.6%

Sample (b) Extractive value :-

- Sample weight = 2g
- Average weight difference = 0.0401
- Extractive value = 0.0401 × 500
- Extractive value = 20.05%

3:- (b) Ethanol soluble extractive value of Millettia pinnata (karanj)

Sr. No.	**Weight of petridish (A)**	**Weight of petridish with sample (B)**	**Difference (A-B)**
1.	37.1807	37.1956	0.0149
2.	35.5245	35.5403	0.0158

- **1st sample weight =2g**

Average weight difference - 0.0149

Ethanol soluble extractive value% = 0.0149 × 500

Extractive value%= 7.45 %

- **2nd sample extractive value**

Sample weight = 2g

Average weight difference = 0.0158

Ethanol soluble extractive value= 0.0158 × 500

Extractive value% = 7.9%

4:- (c) Methanol soluble extractive value Millettia pinnata (karanj) :-

Sr. No.	Weight of petridish (A)	Weight of petridish with sample (B)	Difference
1.	36.6192	36.6563	0.0371
2.	32.8537	32.8912	0.0375

a) 1st sample of Extractive value of methanol :-

Average weight difference = 0.0371

Methanol extractive value = 0.0371 × 500

Extractive value = 18.55 %

b) 2nd sample of Extractive value:-

Average weight difference = 0.0375

Methanol extractive value = 0.03750× 500

Extractive value = 18.75%

5:- (d) Benzene soluble extractive value of millettia pinnata (karanj) :-

Sr. No.	Weight of petridish (A)	Weight of petridish with sample	Difference
1.	32.5550	32.5651	0.0101
2.	33.1388	33.1500	0.0112

1st sample of Extractive value :-

Average weight difference = .0.0101

Benzene extractive value = 0.0101 × 500

Extractive value = 5.05%

2nd sample of Extractive value :-

- Average weight difference = 0.0112
- Benzene extractive value = 0.0112 × 500
- Extractive value = 5.6 %

6 :- (e) acetone soluble Extractive value of millettia pinnata (karanj) :-

1.1stsample of Extractive value:-

- Average of Extractive value = 0.0148

Sr. No.	Weight of petridish (A)	Weight of petridish with sample (B)	Difference
1.	27.6522	27.6670	0.0148
2.	31.4078	31.4218	0.014

- Extractive value = 7.4%

2. 2nd sample of extractive value:-

Average of Extractive value = 0.014

Acetone extractive value = 0.014 ×500

Extractive value = 7. 6 %

7:- (f) chloroform soluble extractive value millettia pinnata (karanj) :-

Sr. No.	**Weight of petridish (A)**	**Weight of petridish with sample (B)**	**Difference**
1.	37.9760	37.9899	0.0139
2.	29.8952	29.9093	0.0141

- 1.1stsample of Extractive value:-

Average of extractive value = 0.0139

Chloroform extractive value = 0.0139 × 500

Extractive value = 6.95%

2nd sample extractive value :-

Average of extractive value = .0.0141

Chloroform extractive value

= 0.0141 × 500

Extractive value = 7.05 %

8.a) Total Ash value of milletia pinnata (karanj) :-

Sr. No.	**Empty weight chinadish (a)**	**Empty weight chinadish+2g sample (b)**	**Weight after in**			**Difference**
			1st (c)	**2nd (d)**	**3rd (e)**	
1.	17.3142	2.0064	17.5189	17.5110	17.5106	0.1964
2.	18.3866	2.0030	18.5912	18.5036	18.5837	0.1971

- Ash value = Difference × 100/2

1st time = 0.1964 × 100/2

= 9.82 %

- **2nd time Ash value**

0.1971 × 100/2

Ash value = 9.85 %

8:- (b) Acid insoluble ash value of milletia pinnata (karanj)

Sr. No.	**1st weight (A)**	**2nd weight (B)**	**3 weight (©**	**Difference (C-A)**
1.	16.8473	16.8481	16.8485	0.0585
2.	18.4494	18.4486	18.4382	0.0516

Sr. No.	Photochemical	Test	Observation	Dist. Water	Methanol	Benzene	Acetone	Chloroform
1.	Carbohydrates	Fehling's test	First yellow then brick red precipitat occurs	+	+	+	+	+
		Benedict test	Appears green, yellow Or red.	+	+	+	+	+
2.	Alkaloids	Wagner's test	Yellow brown	+	+	+	+	+
		Dragendroff's test	Orange or reddish brown precipitat	+	+	+	+	+
		Hager test	Reddish brown precipitat indicates	+	+	+	+	+
3	Flavonoids	Shinoda test	Yellow coloration Occurs	+	+	+	+	+
4.	Saponins	Froth test	Resistance froth of 1-1.5 CM indicate of saponins	+	-	-	-	-
5	Tannins		Greenish colour indicate the presence of white brown colour for tannins.	+	+	+	+	+
6.	Resins	Fecl3	Blue colour	+	+	+	+	+
		Cons. Hcl	Reddish pink	+	+	+	+	+
7.	Phenol	Folins	Brownish green indicates of phenolic compound.	+	Not detected	+	+	+
8.	Test for cardiac Glycosides	Killer killani test	Reddish brown colour at the two liquid layer and upper layer appear.	Not done	Not done	+	+	+
9.	Protein	Buirate test	Formation of red or violet colour indicates the presence of protein.	+	Not done	not done	not done	Not done

- **1st time**
- Sample weight = 2g

= difference × 100/2

= 0.05850a × 100/2

= 2.92 %

- **2nd time**

= Sample weight = 2g

= Diff. × 100/2

= 0=0516 × 100/2

= 2.58 %

9.Preliminary phytochemicals investigation :-

Table :- above show the presence of:-

a) Carbohydrates in all the sample extract of water, methanol, benzene, acetone, chloroform.

b) Alkaloids in all the sample extract of water methanol, benzene, acetone, chloroform.

c) Flavonoids were present in all five extract.

d) Saponins were found present in water extract only.

e) Tannins present were present in all five extract.

f) Resins were found present in water, methanol, benzene, acetone.

g) Phenolic compounds were present in the four extracts except in methanol extract.

h) Cardiac Glycosides were present in three extract except in water and methanol.

i) Protein were found present in only water.

10.FINGERPRINTING PROFILE OF MILLETIAPINNATA PLANT :

Table -10: Rf value of HPTLC fingerprinting profile on milletia pinnata,

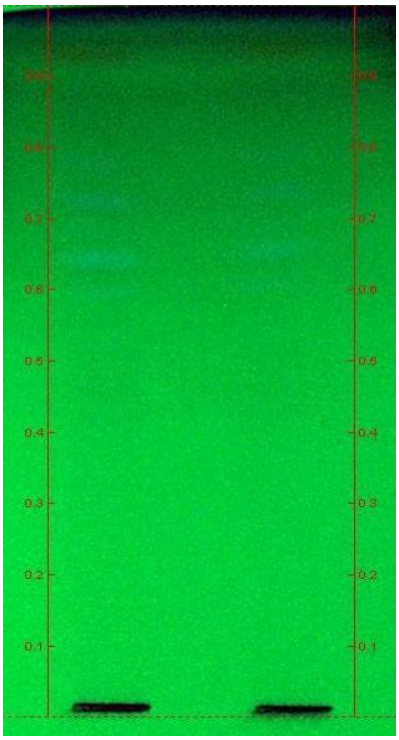
Sr. No.	Rf values	254 nm Before Derivatization	366 nm before Derivatization	366nm after Derivatization
1.	Rf1	0.09(blue)	0.2 (green)	0.2(black)
2.	Rf2	0.18(purple)	0.31(Sky blue)	0.42(green)
3.	Rf3	0.94(green)	0.42(Sky blue)	0.45(sky blue)
4.	Rf4		0.45(Sky blue)	0.53(green)
5.	Rf5		0.52(Sky blue)	0.62(green)
			0.6(Sky blue)	0.64(green)
			0.64(Sky blue)	0.73(green)
			0.7(Blue)	0.81(green)
			0.72(Sky blue)	0.93(red)
			0.79(Blue)	
			0.94(Red)	

Table -show spots at :-

(a):- At 254 nm (before derivatization): fine spots were observed at 0.09(blue), 0.18(purple), 0.94(green).

(b):- At 366nm (before Derivatization) :11 spot were observed at 0.2(green) , 0.31(sky blue), 0.42(sky blue), 0.45(sky blue), 0.52(sky blue), 0.6(sky blue), 0.64(sky blue), 0.7(blue), 0.42(sky blue), 0.79(blue), 0.94(red).

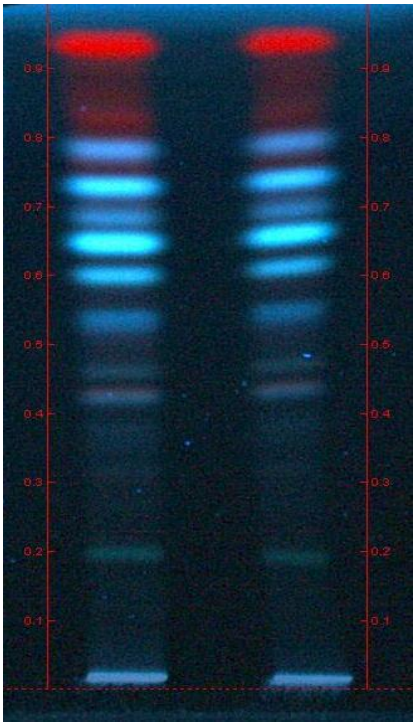
(c.):-At 366nm (after Derivatization) : 9 spot were observed at 0.2(black), 0.42(green), 0.45(sky blue), 0.53(green), 0.62(green), 0.64(green), 0.73(green), 0.81(green), 0.93(red).



A B

254nm

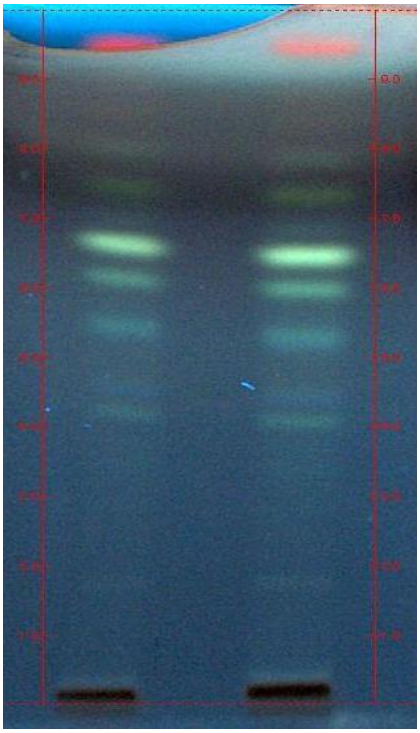
Fig-1



A B

366 nm

Fig-2



366nm after Derivatization

Fig -3

Where :-

Track; A:-Test solution of milletia pinnata.

Track;-B:- Test solution of milletia pinnata.

Conclusion

From the time immemorial, plants have been widely used as curative agents for variety of ailments. the leaves of Millettia pinnata were dried and Paralysed in Pyrolysis reactor. The This analysis creates a platform to screen many bio active chemical constituents present in Millettia pinnata to treat various diseases . In the traditional systems of medicines, such as Ayurveda . the milletia pinnata plant is used for anti-inflammatory, anti-plasmodial, anti-nonciceptive, anti-hyperglycaemic, anti-lipidperoxidative, anti-diarrhoeal, anti-ulcer, anti- hyperammonic and antioxidant activity. The Present Study reveals the presence of various Phytochemical. HPTLC fingerprint can be used as quality evaluation and Standardization of plant powered of milletia pinnata .it can be concluded that plant is a good source of antioxidants due to presence of phenolic and Flavonoid and their derivative. Phytochemical techniques and chemical profile, biological activity characterization may be helpful in development of specific drug of milletia pinnata.

Reference

1:Baker JT, Borris RP, Carté B, Cordell GA, Soejarto DD, Cragg GM, et al. Natural product drug discovery and development: New perspectives on international collaboration. J Nat Prod 1995;58:1325-57.2.

2: Bala M, Nag TN, Kumar S, Vyas M, Kumar A, Bhopal NS. Proximate composition and fatty acid profile of Pongamia pinnata, a potential biodiesel crop. J Am Oil Chem Soc 2011;88:559-62.

3:Sangwan S, Rao DV, Sharma RA. A review on Pongamia pinnata (L.) Pierre: A great versatile leguminous plant. Nat Sci 2010;8:130-9.

4:Ramadevi D, Rao BG, Reddy SJ. Phytochemical and pharmacological studies on Pongamia pinnata. Paripex Indian J Res 2018;7:489-92.

5.Tanaka T, Iinuma M, Yuki K, Fujii Y, Mizuno M. Flavonoids in root bark of Pongamia pinnata. Phytochemistry 1992;31:993-8.

6: Charade VV, Tankar AN, Pande VV, Tekade AR, Gowekar NM, Bhandari SR, et al. Pongamia pinnata: Phytochemical constituents, traditional uses and pharmacological properties: A review. Int J Green Pharm 2008;2:72-5.

7:Meera B, Kumar S, Kalidhar SB. A review of the chemistry and biological activity of Pongamia pinnata. J Med Aromat Plant Sci 2003;25:441-5.

8: Bora Montu Moni, Deka Riblu, Ahmed Nuruddin, Kakati Dilip Kumar. Karanja (Millettia pinnata (L.) Panigrahi) seed oil as a renewable raw material for the synthesis of alkyd resin. Ind. Crops Prod. 2014;61:106–114.

9: Dat Le Duc, Tu Nguyen Thi Minh, Duc Ngo Viet, Luyen Bui Thi Thuy, Hayne Chu Thi Thanh, Jang Hyun Jae, Thu Dang Thi, Huong Tran Thu, Tram Le Hayne, Thong Nguyen Van, Hung Nguyen Duc, Kim Young Ho, Thao. Nguyen Phuong. Anti-inflammatory secondary metabolites from the stems of Millettia dielsiana Harms ex Diels. Carbohydras. Res. 2019;484:

10.Arote S. R. Dahikars. Band yeole R. G, "phytochemicals screening and antibacterial properties of leaves of Pongamia pinnata (fabaceae) from India ", African journal of bio technology Vol 8 pg 6393-6396 16 November 2009.