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RESEARCH STATUS OF BAEL(AEGLE MARMELOS)IN INDIA :A POTENTIAL MEDICINAL TREE

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1.Abstract

Native to India, Bael is one of the earliest known species of fruit trees in the Rutaceae family (Aegle marmelos).

The bael fruits have significant industrial and processing values in addition to its well-known nutritional and traditional medicinal properties.Bael fruit's ability to promote and maintain health is attributed to its fibre content, carotenoids, phenolics, terpenoids, coumarins, flavonoids, and alkaloids.According to Gurvey's literature review, more research is required to determine the mode of action of the bioactive chemicals that have been found, both in vitro and in vivo.

The production of nanoparticles using plants has attracted attention from all around the world due to its affordability, environmental friendliness, and wide range of uses. The current study examined the antibacterial potential of silver nanoparticles (AgNPs) derived from a methanolic extract of Aegle marmelos fruit. The antibacterial activity of solvent extracts (petroleum ether, chloroform, acetone, methanol, and aqueous) and AgNPs was assessed using the Agar well diffusion method. The maximum inhibitory activity against B. Cereus (16.17±0.50 mm) was demonstrated by the methanolic extract of A. Marmelos, which was followed by P. Aeruginosa (13.33 ± 0.62 mm) and E. Coli. The methanolic extract of A. Marmelos underwent phytochemical examination, which showed the presence of flavonoids, glycosides, alkaloids, tannins, saponins, and steroids. AgNPs synthesised using methanolic extract from A. Marmelos were characterised by X-ray diffraction, dynamic light scattering, atomic force microscopy, and UV-visible spectroscopy. The size range of the AgNPs was 159–181 nm, with a peak observed at 436 nm. When the antibacterial potential of green synthesised AgNPs was evaluated, B. Cereus (19.25±0.19 mm) showed the highest inhibitory activity, followed by P. Aeruginosa (16.50±0.30 mm) and S. Dysentriae.

2.Keywords:-Aegle marmelos, Phytoconstituents, Property, Pharmacology Medicinal,Crude extract.

3.Objectives:-

1. Antioxidant: The fruit has antioxidant activity.
2. Antimicrobial: The ethanolic extract of dried fruit pulp is antimicrobial.
3. Antiviral: The fruit has antiviral properties.
4. Anti-diabetic: The fruit has been used as a herbal medicine for diabetes.
5. Hepatoprotective: The aqueous extract of the fruit pulp and seeds is hepatoprotective.
6. Anticancer: The hydroalcoholic extract of the fruit has an anticancer effect.
7. Antiulcer: The fruit can be used to treat ulcers.
8. Antidiarrheal: The fruit can be used to treat diarrhea and dysentery.
9. Radioprotective: A decoction of the unripe fruit with fennel and ginger has radioprotective properties.
10. Antiepileptic: The fruit can be used to treat epilepsy.

4. Introduction

Aegle marmelos (AM) is an important medicinal tree in India, commonly known as Bael fruits, Bel, Indian Bael, Bengal Quince, Belan in English and Shivadruma in Sanskrit, Bel or Bael in Hindi [1] . Fruits are woody shells that are smooth, firm, and green; they are members of the Rutaceae family. Geographically found in Berma as a wild plant and farmed throughout India's Sub-Himalayan region, especially in Central and Southern India [2, 3]. This specific kind of tree, growing to a height of around 12 meters, sheds its leaves every autumn. The Hindu religion places great mythological significance on the Leaf of the AM tree, also known as Tripatra, which is essential to the Lord Shiva ritual.

medicinal plants have been a key source of pharmaceuticals. India has a long history of using plant-based medications for both therapeutic and preventive purposes; these medications have been mentioned in Ayurveda, Siddha, homoeopathy, and other reforms. About 88% of people on the planet utilise plant-based medications as their first line of defence in the fight against several diseases and to maintain their health.[4,5]

Secondary metabolites that are protective to plants include terpenoids, alkaloids, and phenolic compounds (flavonoids, isofla vonoids, and anthocyanins). Terpenoids have become more significant because of their anti-tumor, antiviral, antibacterial, and anticancer properties.Coumarin and its derivatives have been reported to have similar antiv iral efficacy against a wide range of viruses, such as influenza viruses, HIV, enterovirus 71 (EV71), coxsackievirus A16 (CV A16), dengue virus, and chikungunya virus [6,7].

An extensive list of over 21,000 plant species that are used medicinally around the globe has been collected by the globe Health Organization. India uses over 2500 plant species from more than 1000 taxa in its ancient medicinal system. India is the second-most valuable and most prolific exporter of medicinal plants in the world. India is home to one of the 12 main hiodiversity centers in the world, with 16 agroclimatic zones. Fifteen thousand of the about forty-five thousand plant species are flowering species, while seven thousand have been identified as therapeutic plants.[8,9,10]

Table.1

Taxonomical And Vernacular Names Of A.marmelos

Taxonomical classification
Kingdom: Plantae
Division:-Magnoliophyta
Class:- Magnoliopsida
Order:-Sapindales
Family:-Rutaceae
Sub-family:-Aurantioideae
Genus:-Aegle
Species:-A.marmelos
Common name:- Bael Patra, Bael [11]
Vernacular Names
Hindi:- Bel, Beli, Belgiri, Baelputri, sirphal, kooralam
Sanskrit:- Bilva, Shivadruma, Shivaphala, Vilva
English:- Golden apple, Bael fruit, Indian Bael, Holy fruit, Indian quince, elephant apple.
stone apple
Urdu:- Bel, Bel kham
Himachal Pradesh:- Bil Bengal BaelKarnataka Bilpatra, kumbala, malura
Andhra Pradesh:- Maredu
Kerala:- Kuvalum Assamese,
Marathi:- Bel
Gujrati:- Bilivaohal, Bili
Malayalam:- Marredy Oriya Belo
Tamil:- Vilya marum
Telugu:- Bilva pandu Burmese Opesheet, ohshit
French:- Bel indien, cognassier du, Bengale, oranger du Malabar
German:- Belbaum, Schleimapfelbaum, Baelbaum
Portuguese:- Marmelo [12]

4.1.PlantDescription

Description of Plant Often called the "Bale fruit tree," Bael (Aegle Marmelos (Linn) is a little, aromatic tree that grows natur ally in India's deciduous forests. It is somewhat large and slender.It can be found at an kielevation of 1200 meters in the west ern Himalayas and on Andaman Island. The tree is between 6.0 and 7.5 meters tall and has a diameter of 90 to 120 cm. 1121 Since the leaves of this tree are offered to Lord Shiva during devotions, the Hindu community generally views it as sacred. In Hindu mythology, the tree represents Lord Kailashnath in a unique way. 1131 In traditional medicine, this tree's leaves, fruit, stem, and roots are used to treat a variety of illnesses in people of all ages.[13,14].

Bael fruits can be eaten. The pulp that's used to make sweet treats like puddings, murabba, and juice. They are used in several traditional medications to treat chronic diarrhoea, peptic ulcers, inhibit lipid peroxidation, scavenge free radicals, antioxidants, anti-ulcerative colitis, gastroprotective, hepatoprotective, antidiabetic, cardioprotective, radioprotective,

antibacterial, antidiarrheal, and antiviral properties, in addition to being laxatives and respiratory ailments.

Fig No.1 Aegle Marmelos Fruit (Indian Beal)

4.2.Botanical description of fruit of A marmelos:-

Fruit

Fruits have a pericarp, a firm, smooth woody shell, and a fragrant, light orange, fibrous oval, oblong, up to 20 cm diameter. They have a firm core, a light orange flesh, and may take up to a year to mature. [15]

4.2.1.Phytochemical constituents of A. Marmelos:-

Below is a list of the chemical components that were isolated from different parts of the plant. The molecular makeup of some important phytochemicals.

Fruit:-Constituents of A. Marmelos' phytochemistry The fruit component is composed of bioactive components, carbohydrates, volatile chemicals, minerals, vitamins, coumarins, phenolic acids, alkaloids, flavonoids, and organic acids. Carbohydrates (31.80 g/100 g), fibers (2.90 g/100 g), minerals (1.70 g/100 g). Vitamins (0.05 mg/100 g), fats (0.39 g/100 g), riboflavin (0.03 mg/100 g), thiamine (0.13 mg/100 g), beta-carotene (55.0 mg/100 g), and vitamin B2 (1.20 mg/100 g)The Aegle marmelos plant has a variety of nutrients, 35 of which are present.

Table.2

Chemical constituents present in different parts of Aegle marmelos[16]

Plant Part	**Chemical Constituents**
Fruit	Aegeline, marmelin, marmelosin, marmelide, marmesiline. O-methyl halfordinol, alloimperatorin, imperatorin, psoralen, luvangetin, aurapten, O-isopentenyl halfordinol, umbelliferone, scopoletin, 8-sitosterol, xanthotoxin, a- and -amyrin, 6-(4-acetoxy-3-methyl-2-butenyl)-7- hydroxycoumarin, 6-(2-hydroxy-3-hydroxymethyl-3-butenyl)-7-hydroxycoumarin

Table .3

Aegle Marmelos chemical composition, separation technique, and medicinal uses

Sr.No	Metabolites	Phytochemicals	IUPAC Name	Extraction/ Separation Technique
1	Alkaloid	Aegelin	N-(2-hydroxy-2-(4- methoxy phenyl)ethyl cinnarma mide	Chromatography Technique
2	Alkaloid	Marmeline	Z)-N-(2-hydroxy-2-(4-(3-methylbut-2-en-1-yloxy)phenyl)ethyl)-3-phenylacrylamide	
3	Alkaloid	Marmelosin	9-((3-methylbut-2-en-1-yl)oxy)-7H-furo[3.2 glchromen-7-one	
4	Coumarin	Marmelide	9-4(3-methylbut-2-en-1-yl)oxy)-7H-turo 3.2-g/chromen-7-one	Chromatographic Seperation

5	Alkaloid	Omethylhalfordinine	5-(4-(3-methylbut-2-en-1-yloxy)phenyl)-2-(pyndin-3-yoxazole	
6	Coumarin	Alloimperaterin	9-hydroxy-4-(3-methylbut-2-en-1-yl)-7H-furo[3,2-gichromen-7-one	
7	Coumarin	Imperatorin	9-4(3-methylbut-2-en-1-yl)oxy)-7H-furo[3,2-gichromen-7-one	
8	Coumarin	Psoralen	7H-furo 3.2-g/chromen-7-one	
9	Alkaloid	Oisopentenyl halfonlinol	isopentyl isobutyrate	
10	Coumarin	Umbelliferone	7-hydroxy-2H-chromen-2-one	
11	Coumarin	Scopolentin	(E)-7-((2,6-dihydroxy-7-methoxy-7-methyloct-3-en-1-yl)oxy)-2H-chromen-2-one	

4.2.2.Molecular Structure:-

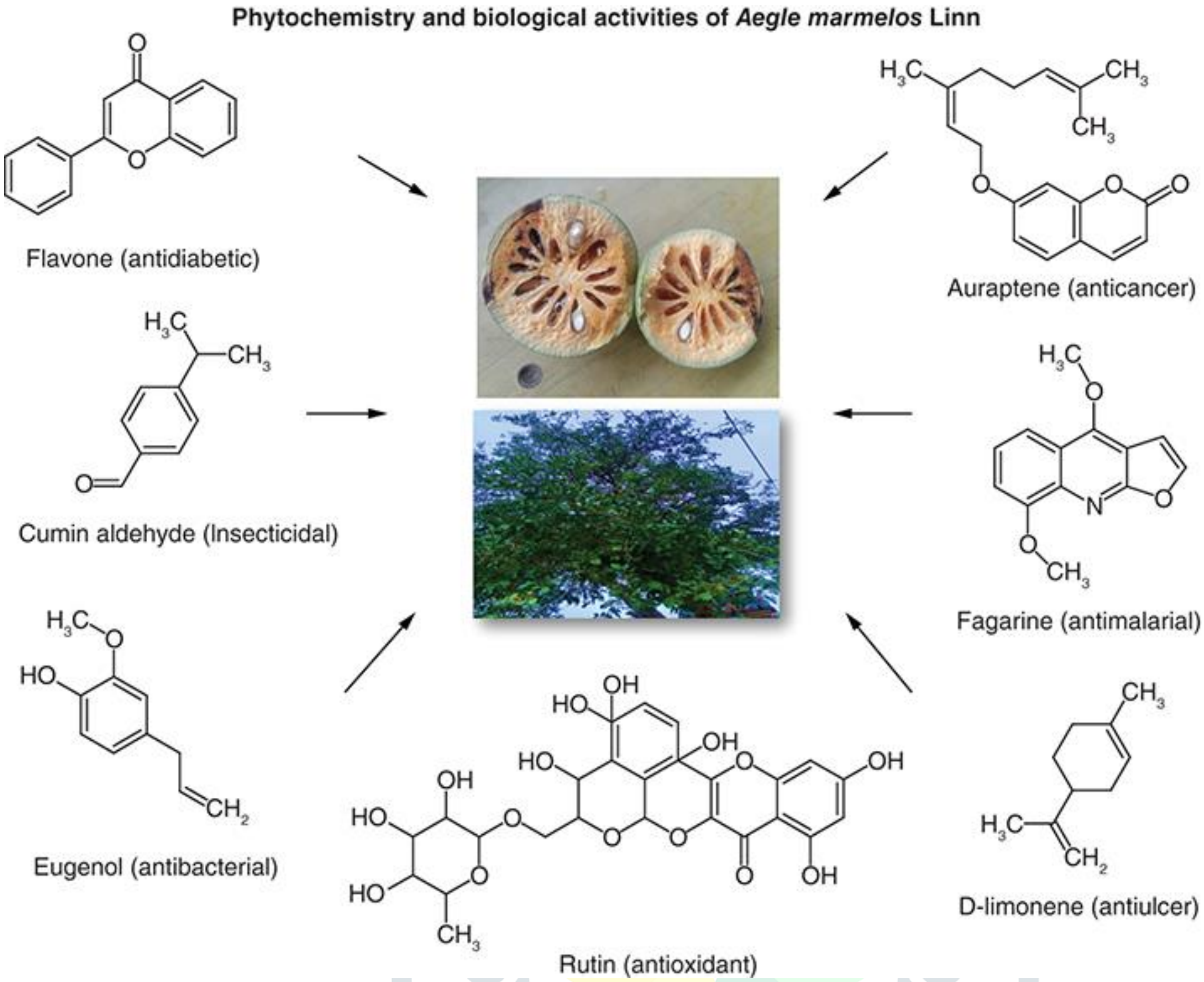

Fig.No.2.Molecular Structure Of Chemical Constituents Of Aegle Marmelos

5.Materials And Method:-

5.1 .Collection of plant material-

Fruits of A. Marmelos, or plant material, were gathered from the Swarghat area in the Himachal Pradesh district of Bilaspur. Mother plants were cleaned, allowed to air dry in the shade on their own, coarsely chopped, and kept in an airtight plastic jar with a clear label for later use.

5.2.Test Organisms-

The bacteria that cause disease are classified as either Gramme positive (Bacillus cereus, Staphylococcus aureus) or Cram negative (Escherichia coli, Pseudomonas aeruginosa, Salmonella typhi, Shigella dysenteriae, Yersinia pestis). They are kept on nutrient agar medium. The bacteria were obtained from Indira Gandhi Medical College and Hospital (IGMC), Shimla (H.P.). chosen test microbes and medications.

5.3.Preparation of plant extracts-

The plant was prepared using the cold percolation process. Extracts made according to Kosenthaler's methodology. After being dried and powdered, the sample was soaked in various solvents (1:10) and continuously stirred at 150 rpm for 24 hours at room temperature. At 40°C, extract filtrates were evaporated until they were completely dry. After further grinding the dried extracts, they were reconstituted in the universal solvent DMSO (dimethyl sulfoxide) to a concentration of 100 mg/ml.

5.4.Determination of antimicrobial potential of plant extracts-

The effect of different plant extracts on pathogenic strains was assayed by agar well diffusion assay and zones of inhibition (mm) were recorded after 24 h of incubation. The MIC of the plant extract required to inhibit the growth of microorganisms was analyzed by Resazurin dye method using plant extract having 2 fold serial di- lutions

5.5.Phytochemical analysis-

Methodology was used in the phytochemical analysis of fruit and leaf methanolic extract in order to identify phytochemicals such as soluble starch, tannins, alkaloids, steroids, saponin, terpenoids, and flavonoids.

5.6.Results-

In this study, the antimicrobial efficiency of different extracts (viz., petroleum ether, chloroform, acetone, methanol and aqueous) Of A. Marmelos plant (i.e. leaf and fruit extracts) were tested against both Gram positive (B. Cereus, S. Aureus) as well as Gram negative (E. Coli, P. Aeruginosa, S. Typhi, S. Dysentrine, Y. Pestis) bacterial pathogens by using the agar well diffusion method. The results of the antimicrobial effects of different parts

6.Biological activities of fruit extracts of Aegle marmelos:-

Native fruit trees are making a substantial economic contribution to the value-added food and pharmaceutical sectors. Likewise, noteworthy attributes. Here, some of the key biological characteristics of Aegle marmelos have been covered.

Table.4

Aegle marmelos demonstrating anticancer effect on various cancer types

Extract/ compound	Cell lines/Animals used	Test method	Mechanism	Conc/ dose (IC values
Fruit extract Hydro alcoholic fruit extract[17]	DMBA induced breast cancer in rats	Biochemical, hormonal and TNF-a assay	Mammary tumor volume Decreased, level of serum. Malondialdehyde (MDA) decreased,	200 mg/kg body weight per day orally for 5 weeks

			glucose level decreased, serum TNF-a level decreased, level of SGPT, SGOT, ALP, creatinine, urea and uric acid decreased	
Fruit extract Hydro alcoholic[18]	Male Swiss albino mice	Gamma radiation-induced cancer in mice	Lipid peroxidation increased in the stomach, intestine, liver and kidney of mice	20 mg/kg for 5 consecutive days

Table.4

Aegle marmelos demonstrating antimicrobial effect on various microbial types

Extract/Compound.	**Test System**	**Test Method**	**Conc./ Dose**	**Zone of Inhibition (mm)/ MIC**
Ethanolic fruit extract[19]	Shigella hoydü, Shigella sonnei, Shigella flexneri .	Agar-well diffusion assay	0.5, 1.0, 2.0 and 40 mg/ml.	500, 250, 400 and 250 µg/ml. respectively
Aqueous fruit extract[20]	Coli Enteropathogenic Escherichia	Rat ileal loop ligation assay using Make BALB/C mice, B-lactamase assay	7X 10 cfu mL (inoculat ed into broth)	500 µg/ml.

7.Extraction And Purification:-

7.1.The MIC of methanolic extract of fruit of A. Marmelos:-00781 mg/100 µl was found to be effective against S. Aureus, Y. Pestis, and B. Cereus. E. Coli, S. Typhi, and P. Aeruginosa showed similar minimum inhibitory concentrations (MICs), measuring 0.1562/100 jul. Nevertheless, S. Dysentriae growth had to be inhibited by an extract concentration of 0.3125 mg/100 µl

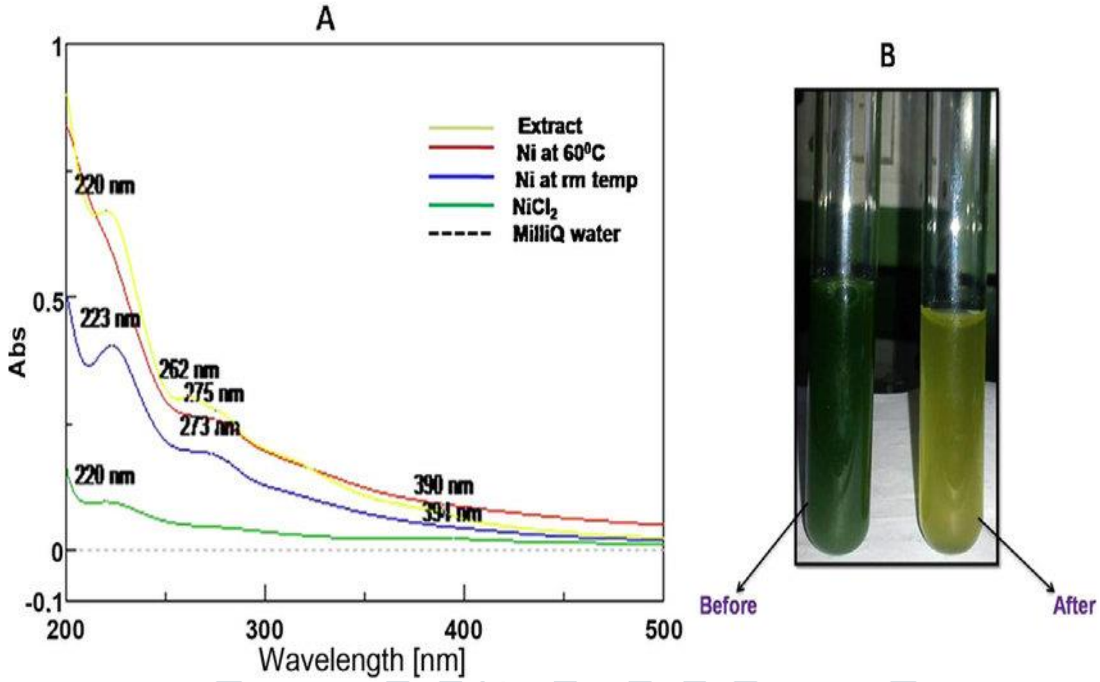

Fig.No.3.Graph Of MethanolicEctract of fruit of A.marmelos

7.2. Preliminary Phytochemical Tests:-

Several chemical tests and chemical assays are included in it. The active chemical components found in crude medicines were quantitatively estimated to determine their purity. The method can be useful for identifying a single active ingredient or a collection of related ingredients found in the same medication.[21]

7.3.Extraction by Continuous hot percolation (Soxalet extraction):-

Using a pastel mortar and mixer, the plant material was ground. The powder was extracted by passing it through mesh No. 10 and retaining it on mesh No. 60. The medication was inserted inside the Soxhlet extractor's body in a paper cylinder made of filter paper. The flask was filled with the solvent. After that, the device was fitted appropriately.[22]

7.4.Seperation of Marmelosin from Extract:-

7.4.1.Thin layer chromatography:- Thin layer chromatography was used to analyse the extract. The TLC method for solvent optimisation for column chromatography employed Stahl's (1965) formolat ed techniques

7.4.2.Column chromatography:-

A solvent is used as the mobile phase and a finely divided material, like silica gel, serves as the stationary phase in coal chromatography. The silica gel slurry was made for the column using a wet technique, with ethyl acetate, methanol, and hexane acting as an eluent in a 1:1:1.5 ratio. The slurry was then cautiously placed into the column. Each test tube held two millilitres of the eluent, which was collected in separate test tubes. After drying the cluent, marinelosin was extracted. Melting point, spectroscopy (IR and NMR), and chemical testing were used to confirm the presence of marmelosin.[23]

8.Chemical Properties Of Marmelosin Constituent:-

Chemical Structure:-

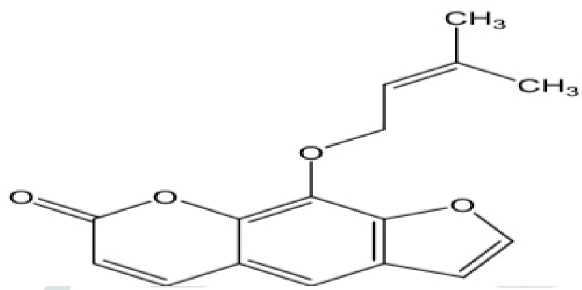

Fig.No.4.Chemical Structure Of Marmelosin

Characterization: Melting point: 99-100 °C, Rf value: 0.52, A max (nm): 282, IR (cm): 3050.45, 1612.25, 2901.25. 1640.25, 1078.71. ‘H NMR (400 MHz, CDCI): 6-8.5(1H. S. Ar-H), 3.3-4(1H, s. C-O-C), 1.7(2H, m, -C-C-CH3. 1.17-1.88(3H. M. -CH)

SYNTHESIS OF MARMELOSIN DERIVATIVE:-

9-[(2-methylprop-1-en-1-yl)peroxy]-5-nitro-7H-furo[3,2-gjchromen-7-One:-

0.35 ml of concentrated nitric acid and 0.4 ml of concentrated sulphuric acid were added to a 250 ml round-bottom flask. To ensure that the temperature stays below 55°C, 0.95 gm of the compound was added to the round, fractured flask before it was submerged in cold water. Following that, a reflux condenser was installed, and the water bath was heated to 60°C for 40–45 minutes while being vigorously shook. The reaction mixture was added to a beaker with 500 millilitres of cold water. The mixture was well mixed, the residual liquid was filtered off, the aqueous layer was disposed of, the residue was dried, and the ethanol was recrystallised.

9.CONCLUSION :-

A. marmelos is a home remedy for a variety of health conditions, including obstruction, peptic ulcer, acid reflux, respiratory problems, loose stools, piles, diabetes, and sexual dysfunction. It also has amazing health benefits and restorative properties. A. Marmelos has a significant protective effect against diseases and illnesses caused by bacteria, viruses, and parasites. Its significance is increased by its excellent flavour and activity, which revives beverages with marmefos. There is now just unorganised sectors in A. Marmelos based processing and product development; nonetheless, its business aspects as value added products are amazing. Large-scale production of fruit products has not yet occurred. Effectively conducted research is necessary to uncover the unknown facts and novel items.

The study suggests that AM and phytoconstituents can be used to develop unique formulations for managing, mitigating, and preventing cancer, diabetes, and other microbial diseases. However, extensive research is needed to understand the pathophysiology and pharmacology of various phytochemicals and their efficacy.[24]

10.Reference:-

1. Scapino L, Zondag HA, Van Bael J, Diriken J, Rindt CC. Sorption heat storage for long-term low-temperature applications: A review on the advancements at material and prototype scale. Appl Energy. 2017;190:920-48.

2. Neeraj VB, Joluar V. Bael (Aegle marmelos) extraordinary species of India: A review. Int J Curr Microbiol Appl Sci. 2017:6(3):1870-87.

3. Ezhilarası AA, Vijaya JJ, Kaviyarasu K, Kennedy LJ. Ramalingam RJ, Al-Lohedan HA. Green synthesis of NiO nanoparticles using Aegle marmelos leaf extract for the evaluation of in-vitro cytotoxicity, antibacterial and photocatalytic properties. J Photochem Photobiol B. 2018;180:39-50.

4. Anhulkarad M, Thomas M. Sundararajan M. Ceraldine P Gas chromatography-mats spectrometry analysis and in vitro antioxidant activity of the ethanolic extract of the leaves of Tabernaemontone divericato, Pharm 201808:451-458.

5. Biswas A. Delmath A, Giri X, Acharya S Gautam M. Determination of the antioxiciant and antimicrobial actities of Azadirachta indica extract Int J pharm Eng.2015;562-573

6. Oz, A.T; Kafkas, F. Phytochemicals in Fruits and Vegetables. In Sarperfood and Functional Food: IntechOpen: London, UK, 2017;pp . 175-184.

7. Zia-Ul-Haq, M. Historical and Introductory Aspects of Carotenoids. In Carotenoids: Structure and Function in the Harman Body,Zia-Ul-Haq, M., Dewanjee, S, Kiaz, M., Eds., Springer: Cham, Switzerland, 2021; pp. 1-42.

8. Gupta M, Biswas TK, Saha S and Debnath PK, Therapeutic utilization of secretory products of some Indian medicinal Plants: A review, Indian J Trad Knowledge, 2006; 5(4): 569-575.

9. Setia G, Luthra P and Sharma PC, Siddha System: An ancient heritage of India, In: Proceedings of National Seminar on Role of Medicinal and Aromatic Plants in Ayurvedic, Unani and Siddha systems of medicine. Hisar, 2005; 11-14.

10. Jain JB, Kumane SC and Bhattacharya S. Medicinal flora of Madhya Pradesh and Chhattisgarh A review, Indian J Trad Knowledge, 2006; 5(2): 237-242.

11. S. Charoensiddhi and P. Anprung, “Characterization of bael fruit (Aegle marmelos [L.] correa) hydrolysate as affected by enzyme treatment,” Journal of Food Biochemistry, 2009: 34: 1249 1267.

12. S. N. Arseculeratne, A. A. L. Gunatilaka, and R. G. Panabokke, “Studies on medicinal plants of Sri Lanka. Part 14: toxicity of some traditional medicinal herbs,” Journal of Ethnopharmacology, 1985; 13(3): 323-335.

13. C.S.I.R. (1985), “ The wealth of India” National Institute of Science communication and Information Resources”, Volume I (A), 86.

14. Purohit S. S and Vyas S. P, “In: Aegle marmelos Correa ex Roxb, (Bael), Medicinal plant Cultivation- A scientific approach”, Agrobios, Jodhpur, 2004; 498-504.

15. Swingle WT. Botany of citrus and its wild relatives of the orange subfamily (family Rutaceae, subfamily Aurantioideae), 1943; 12.

16. Phawapraisirisan P., Puksasook T., Jong-aramruang J. And Kokpol U, Phenylethyl cinnamides a new series of alpha- glucosidase inhibitors from the leaves of Aegle marmelos, Bioorg. Med. Chem. Lett., 18(18), 4956-4958 (2008)

17. Akhouri V., Kumari M. And Kumar A., Therapeutic effect of Aegle marmelos fruit extract against DMBA induced breast cancer In rats. Sci. Rep., 10, 18016 (2020)

18. Jagetia G.C., Venkatesh P. And Baliga M.S., Evaluation of the radioprotective effect of Aegle marmelos (L.) Correa in cultured hurman peripheral blood lymphocytes
exposed to different doses of y-radiation: a micronucleus study, Mutagenesis, 18(4), 387-393(2003)

19.Joshi PV, Patil R.H. and Maheshwari V.L., In-vitro antidiarrhoel activity and toxicity profile of Aegle marmelos Correa ex Roxb. Dried fruit pulp, Nat. Prod. Rodionce, 8(5), 498- 502 (2009)

20.Raja S.B., Murali M.R., Malathi G.K., Anbarasa K. And Devaraj S.N., Effect of Aqueous Extract of Aegle marmelos Fruit on Adherence and B-Lactam Resistance of Enteropathogenic Escherichia coli by Down Regulating Outer Membrane Protein C, Am. J. Infect. Dis., 5(2), 154-162 (2009)

21.Quality control methods for medicinal plant materials" published by WHO, Geneva, 1998, 30.

22.Kokate CK, Purohit AP, Gokhale SB, "Pharmacognosy, 34th edition, Nirali Prakashan, pune, 105

23. Adamovics JA, "Chromatographic analysis of pharmaceuticals" Marcel Dekker, Inc. 2 edition 1997, 57-72.

24. Kothari S. Minda M. Tonpay SD. Anxiolytic and antidepressant activities of methanol extract of Aegle marmelos leaves in mice. Indian J Physiol Pharmacol, 2010 Oct 1; 54(4): 318-28.

25.Dhiman AK, In: Discussion of Plants, Sacred Plants and their Medicinal Uses, Daya Publication House, New Delhi, 2003: 18-19.

26. Agarwal VS, Economic Plants of India, Kailash Parkashan, Calcutta, 1990; 3-9.

27.Dhiman AK, In: Discussion of Plants, Sacred Plants and their Medicinal Uses, Daya Publication House, New Delhi, 2003: 18-19.

28.Seemaisamy R, Faruck LH, Gattu S, er al. Anti Microbial and Anti Cancer activity of Aegle marmelor and Gas Chromatography Coupled Spectrometry Analysis of their Chemical Constituents. Int. J. Pluram. Sci. Res. 10(1), 373-380 (2019).

29. Akhomi V, Kumari M. Kumar A. Therapeutic effect of Aegis maroneles fruit extract against DMBA induced breast cancer in rats. Si mper 1011), 18016 (2020).

30.Angajala G, Pavan P, Subashini R. One step biofabrication of copper nanoparticles from Aegle marmelos Correa aqueous leaf extract and evaluation of its anti-inflammatory and mosquito larvicidal efficacy. RSC Adu 4(93). 51 459-51470 (2014).

31.Bhardwaj R. Nandal U. Nutritional and therapeutic potential of hael (Aegle marmelos Corr.) fruit juice: A Review. Nutr Food Sci. 2015:45(6):895-919.

32.Neeraj VB. Johar V. Bael (Aegle marmelos) extraordinary species of India: A review. Int J Curr Microbiol Appl Sci. 2017;5(3):1870-87.

33.Barhe P. Diwane C. Waghmare P. Patil V. Jadhav P.Review on Aegle marmelos. World J Pharm Res. 2022;11(4):716-29.

34.Sahu B. Sahu M. Sahu M. Yadav M. Sahu R. Sahu C.An updated review on Nelumbo Nucifera Gaertn: Chemical composition, nutritional value and pharmacological activities. Chem Biodiversity. 2024 202301493.