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Ethno botanical and phytopharmacological recent review of *Aegle marmelos* medicinal values

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Abstract

This review was undertaken to find out the ethnobotanical and phytopharmacological review of *Aegle marmelos*. Extensive information about the plant has been together from various books, journals and Ayurvedic classical texts, unpublished data, expected research etc. Researchers, pharmacologists and Ayurveda treatment possibly determine and help the security of plant. *Aegle marmelos* worn for the long period in various chronic diseases in traditional medicine. Yearning of the current review is to search the literature for the pharmacological properties, toxicity studies, pharmacology studies, Antibacterial and Antifungal, phytochemical exploration of Anti-inflammation, Anti-diabetic studies, antioxidant etc., and the amassed data helpful for the researchers to give attention on the significant areas of research yet to be revealed This Natural medicinal plant should be initiated towards conservation. Research plans involving drug synthesis mediating this medicinal plant might use this review approaches in future drug designing studies and formulate appropriate ideologies.

Keywords: *Aegle marmelos*, antioxidant, ayurvedic, novel drug, ethno botanical

Introduction

India is a country with large ethnic society and has immense wealth due to which it is rich in biodiversity. There are 45,000 species of wild plant out of which 9,500 species are ethno botanically important species (Abhijit Dutta *et al.*, 2014) [2]. Apart from being a medicinal plant, *Aegle marmelos* is a sacred tree, dedicated to Lord Shiva. The offering of *bael* leaves is a compulsory ritual while the worship of Lord Shiva in the hills. This importance seems largely due to its medicinal properties. All parts of this tree, viz., root, leaf, trunk, fruit and seed, are used for curing one human ailment or another (Parmar, and Kaushal. 1982) [3]. All parts of the tree are used as herbal medicine in Ayurved, Unani and Siddha systems of medicine for the treatment of various ailments like dysentery, dyspepsia, chronic diarrhea (Sankeshi *et al.*, 2013 and Reddy *et al.*, 2012) [4, 5]. Herbal drugs are traditionally used in various parts of the world to cure different diseases. The trend of using natural products has increased and the active plant extracts are frequently screened for new drug discoveries (Sridhar, 2002) [6]. 'Bael tree' is native to India and a sacred plant to Hindus. It has got immense medicinal values. The Bael leaves are also used on Vinayakachavithi festival to worship Lord Ganesha (Sampath kumar *et al.*, 2012) [7]. *Aegle marmelos* Linn. Is a perennial tree, wild in the sub Himalaya tract, central and South India This plant is commonly called as Bael in Hindi, Vilvam in Tamil and Bilva in Sanskrit? It belongs to the family Rutaceae. It is indigenous to India and is used in folk medicines. The Ayurvedic practitioners use almost all of their parts but the greatest medicinal value ascribed to its fruits. Oxidative stress is produced during normal metabolic process in the body as well as induced by a variety of environmental and chemical factors which cause generation of various reactive free radicals and subsequent damage to macromolecules like DNA, Proteins and Lipids. No specific scientific evaluation of antioxidant activity of *A. marmelos* fruit pulp has been reported so far (Rajan *et al.* 2011) [8]. The phytochemical research based on ethno-pharmacological information is generally considered an effective approach to the discovery of new effective agents from plant extracts it is used to identify secondary metabolites Tamizhazhagan *et al.*, 2017) [9]. Uncontrolled diarrhea is dangerous as it can lead to loss of body fluid results in electrolyte imbalance. Excessive loss of body fluid results in severe dehydration and death. In developing countries, diarrhea continues to be one of the leading causes of mortality and morbidity in children less than 3 years old. According to World Health Report, diarrhea is cause of 3.3% of all deaths. Worldwide distribution of diarrhea accounts for more than 5 – 8 million deaths each year in children. The incidence of diarrhoeal disease still remains high despite the effort by many government and international organizations to reduce it (Shariff *et al.*, 2010, Sunilson *et al.*, 2009, Chitme *et al.*, 2004) [9, 11]. They are regarded secondary metabolic activity because the

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plants that manufacture them may be having little need for the human population (Tamizhazhagan and Pugazhendy, 2017) [72]. Asia has abundant species of medicinal and aromatic plants and traditional medicines have practiced in Asia since ancient times. India has made use of medicinal plants to cure ailments since thousands of years (Tamizhazhagan *et al.*, 2017) [73]. Hence, in the present review monitoring plant conservation and awareness develops secured modern life. This review might extend help to investigators, health professionals, scientists and scholars working in the field of pharmacology and therapeutics to develop various drugs synthesis routes and build new remedies for various diseases Table 1 and 2.

Table 1: *Aegle marmelos* classification

Kingdom	Plantae – Plants
Subkingdom	Tracheobionta – Vascular plants
Superdivision	Spermatophyta – Seed plants
Division	Magnoliophyta – Flowering plants
Class	Magnoliopsida – Dicotyledons
Subclass	Rosidae
Order	Sapindales
Family	Rutaceae
Genus	<i>Aegle</i> Corr. Serr. – <i>aegle</i> P
Species	<i>Aegle marmelos</i> (L.) Corr. Serr. – <i>Indian bael</i> P (Figure 1)



Fig 1: *Aegle marmelos*, plant

Table 2: Phytomedicine Studies of *Aegle marmelos*

S.No	Phytomedicine Studies	Reference
1.	Antioxidant Activity	[12,14,31-38,96-98]
2.	Pollination efficiency	[13,14]
3.	Wound Healing Activity	[17]
4.	Anti-Diabetic activity	[18-21,39-43]
5.	Hepatoprotective activity	[22-23,76]
6.	Antimicrobial activity	[24-27,83-90]
7.	Antiulcer activity	[28-30]
8.	Anti-inflammatory activity	[44-47]
9.	Antifungal activity	[48-50]
10.	Antibacterial activity	[51-54]
11.	Antiviral activity	[55-58]
12.	Anticancer activity	[59-64,77-78]
13.	Radioprotective activity	[65,59,91-94]
14.	Antihyperlipidaemic activity	[36,43,66]
15.	Antifertility activity	[74,95]
16.	Antidiarrhoeal activity	[79-82,100-101]

Number indicate [] references

General information of Antioxidant Activity

Antioxidants that are reducing agents can also act as pro-oxidants. For example, vitamin C has antioxidant activity when it reduces oxidizing substances such as

hydrogen peroxide; however, it will also reduce metal ions that generate free radicals through the Fenton reaction.

Pollination efficiency

Pollination is important because it leads to the production of fruits we can eat, and seeds that will create more plants. Pollination begins with flowers. Flowers have male parts that produce very small grains called pollen. Pollination is the transfer of pollen grains from one flower to another.

Wound Healing Activity

Wound healing is a natural restorative response to tissue injury. Healing is the interaction of a complex cascade of cellular events that generates resurfacing, reconstitution, and restoration of the tensile strength of injured skin.

Anti-Diabetic activity

Drugs used in diabetes treat diabetes mellitus by lowering the glucose level in the blood. With the exceptions of insulin, exenatide, liraglutide and pramlintide, all are administered orally and are thus also called oral hypoglycemic agents or oral anti-hyperglycemic agents.

Hepatoprotective activity

Hepato protection or anti-hepatotoxicity is the ability to prevent damage to the liver. This is opposite to the hepatotoxicity.

Antimicrobial activity

Antimicrobial activity refers to the process of killing or inhibiting the disease causing microbes. Various anti-microbial agents are used for this purpose. Antimicrobial may be anti-bacterial, anti-fungal or antiviral.

Antiulcer activity

Other antiulcer drugs include mucosal protective agents such as sucralfate and prostaglandin analogues (misoprostol). Sucralfate (Carafate and others) is a sulfated polysaccharide that becomes a viscous polymer adhering to ulcers in mucosal surfaces and aiding in healing.

Anti-inflammatory activity

Nonsteroidal anti-inflammatory drugs (NSAIDs) are drugs that help reduce inflammation, which often helps to relieve pain. In other words, they're anti-inflammatory drugs.

Antifungal activity

An antifungal medication, also known as an antimycotic medication, is a pharmaceutical fungicide or fungistatic used to treat and prevent mycosis such as athlete's foot, ringworm, candidiasis (thrush), serious systemic infections such as cryptococcal meningitis, and others.

Antibacterial activity

Medicinal plants are considered new resources for producing agents that could act as alternatives to antibiotics in the treatment of antibiotic-resistant bacteria. The aim of this study was to evaluate the antibacterial activity of 28 plant extracts and oils against four Gram-negative bacteria species.

Antiviral activity

Antiviral drugs are a class of medication used specifically for treating viral infections rather than bacterial ones. Most antivirals are used for specific viral infections, while a

broad-spectrum antiviral is effective against a wide range of viruses.

Anticancer activity

The MTT/MTS *in vitro* cell proliferation assay is one of the most widely used assays for evaluating preliminary anticancer activity of both synthetic derivatives and natural products and natural product extracts. The highly reliable, colorimetric based assay is readily performed on a wide range of cell lines.

Antifertility activity

Capable of or tending to reduce or destroy fertility: contraceptive antifertility agents.

Conclusion

Medicinal plant *Aegle marmelos* is used as an important ingredient in many Ayurvedic formulation and as a phyto medicine compound just on basis of its traditional medicinal uses. It might generate researchers a good novel drug design and drug development using such a potent medicinal plant. It has made revolution in India's indigenous Ayurvedic medicine system. Various Cultivated, Natural medicinal plants should be initiated towards conservation. Research plans involving drug synthesis mediating through these medicinal plants might use this review approaches in future drug designing studies and formulate appropriate ideologies.

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References

- Baitule MM, Gawande AP, Kumar U, Sahatpure SK, Patil MS, Baitule MM. Effect of *Aegle marmelos* and *Murraya koenigii* in treatment of delayed pubertal buffalo's heifers. *Veterinary world*. 2016; 9(12):1375.
- Dutta A, Lal N, Naaz M, Ghosh A, Verma R. Ethnological and Ethno-medicinal importance of *Aegle marmelos* (L.) Corra (Bael) among indigenous people of India. *American Journal of Ethnomedicine*. 2014; 1(5):290-312.
- Parmar, C, Kaushal MK. *Aegle marmelos*. In: Wild Fruits. Kalyani Publishers, New Delhi, India, 1982, 1-5.
- Sankeshi V, Kumar PA, Naik RR, Sridhar G, Kumar MP, Gopal VH, *et al*. Inhibition of aldose reductase by *Aegle marmelos* and its protective role in diabetic cataract. *J Ethno pharmacol*. 2013; 149(1): 215-21.
- Reddy PV, Sahana N, Urooj A. Antioxidant activity of *Aegle marmelos* and *Psidium guajava* leaves. *IJMAP*. 2012; 2(1):155-60.
- Sridhar GR. Psychosocial and cultural issues in diabetes mellitus. *Current Science*. 2002; 83(12):1556.
- Kumar KS, Umadevi M, Bhowmik D, Singh DM, Dutta AS. Recent trends in medicinal uses and health benefits of Indian traditional herbs *Aegle marmelos*. *The Pharma Innovation*. 2012; 1:1(4).
- Rajan S, Gokila M, Jency P, Brindha P, Sujatha RK. Antioxidant and phytochemical properties of *Aegle marmelos* fruit pulp. *Int J Curr Pharm Res*. 2011; 3(2):65-70.
- Tracy JL, Shariff AF, Cheng JT. A naturalist's view of pride. *Emotion Review*. 2010; 2(2):163-77.
- Sunilson JA, Suraj R, Rejitha G, Anandarajagopal K, Kumari AV, Promwichit P. *In vitro* antimicrobial evaluation of Zingiber officinale, Curcuma longa and Alpinia galanga extracts as natural food preservatives. *American Journal of Food Technology*. 2009; 4(5):192-200.
- Chitme HR, Chandra R, Kaushik S. Studies on anti-diarrhoeal activity of *Calotropis gigantea* R. Br. in experimental animals. *J Pharm Pharm Sci*. 2004; 25:7(1):70-5.
- Charoensiddhi S, Anprung P. Bioactive compounds and volatile compounds of Thai bael fruit (*Aegle marmelos* (L.) Corra) as a valuable source for functional food ingredients. *International food Research journal*. 2008; 15(3):287-95.
- Satapathy SN, Chandra U. Pollination efficiency of insect pollinators on *Aegle marmelos* Corra. At Kumarganj, Faizabad. *Journal of Entomology and Zoology Studies*. 2017; 5(4):570-2.
- Singhal VK, Salwan A, Kumar P, Kaur J. Phenology, pollination and breeding system of *Aegle marmelos* (Linn.) Corra (Rutaceae) from India. *New Forests*. 2011; 42:85-100.
- Mona Kejariwal. Evaluation of Antioxidant Potential and Phytochemical investigations on *Aegle marmelos* (L.) Corra. *Bull. Env. Pharmacol. Life Sci*. 2016; 5(2):42-52.
- Jaswant Akilandeswari V, Loganathan S, Manimaran Ruckmani, Wound healing activity of *Aegle marmelos*" *Indian J Pharm. Sci*. 2001; 63(1):41-44.
- Upadhya S, Shanbhag KK, Suneetha G, Naidu BM, Upadhya S. A study of hypoglycemic and antioxidant activity of *Aegle marmelos* in alloxan induced diabetic rats", *Ind. J Physiol. Pharmacol*. 2004; 48:476-480.
- Marzine PS, Gilbert R. The effect of an aqueous extract of *A. marmelos* fruits on serum and tissue lipids in experimental diabetes, *J Sci. Food Agriculture*. 2005; 85(4):569-573.
- Sundaram EN, Raddy Uma Maheswara P, Singh KP. "Effect of Alcoholic Extracts of Indian Medicinal Plants on the Altered Enzymatic Activities of Diabetic Rats", *Indian Journal of Pharmaceutical Sciences*. 2009; 71(5):594-598.
- Kuttan R, Sabu MC. "Antidiabetic activity of *Aegle marmelos* and its relationship with its antioxidant properties", *Indian J Physiol Pharmacol*. 2004; 48(1):81-88.
- Hema CG, Lalithakumari K. "Screening of Pharmacological actions of *Aegle marmelos*", *Indian J Pharmacol*. 1999; 20:80-85.
- Singan V, Singan M, Begum H. "The hepato protective effect of bael leaves (*Aegle marmelos*) in alcohol induced liver injury in albino rats"; *International Journal of Science & Technology*. 2007; 2(2):83-92.
- Singh R, Singh H Rao. "Hepato protective effect of the pulp/seed of *Aegle Marmelos* correa ex Roxb against carbon tetrachloride induced liver damage in rats" *International Journal of Green Pharmacy*, 2008, 232.
- Maheshwari VL, Joshi PV, Patil RH. *In vitro* anti diarrhoeal activity and toxicity profile of *Aegle marmelos* Corra ex. Roxb. Dried fruit pulp, *Natural Product Radiance*. 2009; 8(5):498-502.
- Kaur S, Kaur P, Walia A, Kumar S. "Antigenotoxic Activity of Poly phenolic Rich Extracts from *Aegle marmelos* (L.) Corra in Human Blood Lymphocytes and *E. coli* PQ 37"; *Rec. Nat. Prod*. 2009; 3(1):68-75.

26. Citarasu T, Rajajeyasekar R, Venkatmalingam K, Dhandapani PS, Peter Marian M. Effect of wood apple *Aegle marmelos*, Correa (Diacotyledons, Sapindales, Rutaceae) Extract as an antibacterial agent on pathogens infecting prawn (*Penaeus indicus*) larviculture", Indian Journal of Marine Sciences. 2003; 32(2):156-161.
27. Wallace JL, Granger DN. The cellular and molecular basis of gastric mucosal defense. *Faseb. J.* 1996; 10:731.
28. Karakaya S. Bioavailability of phenolic compounds. *Crit. Rev. Food Sci. Nutr.* 2004, 44:453.
29. Bandy opadhyay U, Biswas K, Chatterjee R, Bandyopadhyay D, Chattopadhyay I, Ganguly CK, *et al.* Gastroprotective effect of neem (*Azadirachta indica*) bark extract: possible involvement of H⁺-K⁺-ATPase inhibition and scavenging of hydroxyl radical. *Life Sci.* 2002; 71:2845.
30. Wallace JL, Granger DN. The cellular and molecular basis of gastric mucosal defense. *Faseb J.* 1996; 10:731.
31. Karakaya S. Bioavailability of phenolic compounds. *Crit. Rev. Food Sci. Nutr.* 2004, 44:453.
32. Bandyopadhyay U, Biswas K, Chatterjee R, Bandyopadhyay D, Chattopadhyay I, Ganguly CK, Chakraborty T, Bhattacharya K, Benerjee RK Gastroprotective effect of neem (*Azadirachta indica*) bark extract: possible involvement of H⁺-K⁺-ATPase inhibition and scavenging of hydroxyl radical. *Life Sci.* 2002; 71:2845.
33. Sabu MC, Kuttan R. Antidiabetic activity of *Aegle marmelos* and its relationship with its antioxidant properties. *Ind. J Physiol. Pharmacol.* 2004; 48:81.
34. Kamalakkannan N, Stanely M, Prince PS. Effect of *Aegle marmelos* Correa (Bael) fruit extract on tissue antioxidants in Streptozotocin diabetic rats. *Indian J Exp. Biol.* 2003; 41:1285.
35. Chakrabarti B, Mallick C, Bhattachaya S. Studies on the effect of green leaves of *Aegle marmelos* and piper nigrum on the glucose and cholesterol levels of blood in diabetes mellitus. *Ind. Med. Forum.* 1960; 9:285.
36. Rajadurai M, Prince PS. Comparative effects of *Aegle marmelos* extract and alpha-tocopherol on serum lipids. Lipidperoxides and cardiac enzyme levels in rats with isoproterenol-induced myocardial infarction. *Singapore Med. J.* 2005; 46:78.
37. Upadhyaya S, Shanbhag KK, Suneetha G, Balachandra naidu M, Upadhyaya S. A study of hypoglycemic and antioxidant activity of *Aegle marmelos* in alloxan induced diabetic rats. *Ind. J Physiol. Pharmacol.* 2004; 48:476.
38. Cicerale S, Lucas Lisa, Keast R. Biological Activities of Phenolic Compounds. *Int. J Mol. Sci.* 2010; 11 (2):458-479. Funk *et al* 2011.
39. Vidhya N, Devaraj SN. Antioxidant effect of Eugenol in rat intestine. *Indian J Exp. Biol.* 1999; 37:1192.
40. Kamalakkanan N, Rajadurai M, Prince PS. Effect of *Aegle marmelos* fruits on normal and Strep tozotocin diabetic Wistar rats. *J Med. Food.* 2003; 6:93.
41. Ceriello A. Oxidative stress and diabetes –associated complications. *Endocr. Pract.* 2006; 12:60.
42. Kamalakkanan N, Prince PS. Anti-hyper lipidaemic effect of *Aegle marmelos* fruit extract in Strep tozotocin-induced diabetes in rats. *J Sci. Food Agric.* 2005; 85:569.
43. Kamalakkanan N, Prince PS. Hypoglycemic effect of water extracts of *Aegle armelos* fruits in Streptozotocin diabetic rats. *J Ethnopharmacol.* 2007; 87:207.
44. Purohit SS, Vyas SP. In A. marmelos Correa ex Roxb (bael), Medicinal Plant Cultivation- A scientific Approach, Agrobios, Jodhpur. 2004, 00280-285.
45. Getha T, Varalakshmi P. Anti-inflammatory activity of lupeol and lupeol linoleate in rats. *J Ethnopharmacol.* 2001; 76:77.
46. Arul V, Miyazaki S, Dhananjayan R. Studies on the anti-inflammatory, antipyretic and analgesic properties of the leaves of *Aegle marmelos* Correa. *J Ethnopharmacol.* 2005; 96:159.
47. Macglashan D. Histamine a mediator of inflammation. *J Allergy Clin. Immunol.* 2003; 53:112.
48. NK. Antifungal activity of essential oil of *Aegle marmelos* Correa (Rutaceae). *Ind. Drugs Pharmaceut.* 1977; 12:55.
49. Pitre S, Srivastava SK. Pharmacological, microbiological and phytochemical studies on the roots of *Aegle marmelos*. *Fitoterapia.* 1987; 58:197.
50. Pelzar MJ, Chan EC, Krig NR. Biological activities of crude extracts and chemical constituents of Bael, *Aegle marmelos* (L.) Corr. *Microbiol.* 1998; 5:94.
51. Joshi CG, Magar NG. Antibiotic activity of some Indian medicinal plants. *J Sci. Ind. Res.* 1952; 11:261.
52. Pandey DK, Asthana A, Tripathi NN, Dixit SN. Volatile plant products vis-à-vis potato pathogenic bacteria. *Ind. Perfum.* 1981; 10:25.
53. Rusia K, Srivastva SK. Antimicrobial activity of some Indian medicinal plants. *Ind. J Pharmaceut. Sci.* 1988; 50:57.
54. Duke JA. Handbook of biologically active phytochemicals and their activities (CRC press), 1992.
55. Badam L, Bedekar SS, Sonawane KB, Joshi SP. *In vitro* antiviral activity of Bael (*Aegle marmelos* Corr) upon human coxsackie viruses B1-B6. *J Common Dis.* 2002; 34:88.
56. Fenner FJ, Gibb EPJ, Murphy FA, Rott R, Studdart MJ, White D. *Veterinary virology* (Academic press Inc) London, UK. 1993; 2:301.
57. Dhar ML, Dhar MM, Dhavan BN, Mehrotra BN, Ray C. Screening of Indian plant for biological activity. *Indian J Exp. Biol.* 1968; 6:232.
58. Babbar OP, Jhoshi MN, Madan AR. Evaluation of plants for antiviral activity. *Indian J Med. Res.* 1982; 56:76.
59. Jagetia GC, Venkatesh P, Baliga MS. Evaluation of the 1506 J Med. Plant. Res. Radio protective effect of *Aegle marmelos* (L.) Correa in cultured human peripheral blood lymphocytes exposed to different doses of gamma-radiation: a micronucleus study. *Mutagenesis.* 2003; 18:387.
60. Lampronti I, Matello D, Bianchi N, Borgatti M, Lambertini E, Piva R, *et al.* *In vitro* antiproliferate effects on human tumour cell lines of extract from the Bangladeshi medicinal plant *Aegle marmelos* Correa. *Phytomed.* 2003; 10:300-308.
61. Costa-Lotulo LV, Khan MT, Ather A, Wilke DK, Jimenez PC, Pessoa C, *et al.* Studies of the anticancer potential of plants used in Bangladeshi folk medicine. *J Ethnopharmacol.* 2005; 21:99.
62. Lambertini E, Piva R, Khan MT, Lampronti I, Bianchi N, Borgatti M, *et al.* Effect of xtracts from Bangladeshi medicinal plants on *in vitro* proliferation of human breast cancer cell lines and expression of estrogen receptor alpha gene. *Int. J Oncol.* 2004; 24:419.
63. Gangadevi V, Muthumary J. Taxol, an anticancer drug produced by an endophytic fungus *Bartalinia*

- robillardoides*, isolated from a medicinal plant, *Aegle marmelos* Correa ex Roxb. World J Microbial Biotechnol. 2008; 24:717-724.
64. Jagetia GC, Venkatesh P, Baliga. Evaluation of the radioprotective effect of *Aegle marmelos* (L.) Correa in cultured human peripheral blood lymphocytes exposed to different doses of γ -radiation: a micronucleus study. Mutagenesis. 2003; 18(4):387-393.
 65. Kesari AN, Gupta RK, Singh SK, Diwakar S, Watal G Hypoglycemic and anti-hyperglycemic activity of *Aegle marmelos* seed extract in normal and diabetic rats. J Ethnopharmacol. 2006; 107:374.
 66. Vijaya C, Ramanathan M, Suresh B. Lipid lowering activity of ethanolic extract of leaves of *Aegle marmelos* (Linn.) in hyper lipidaemic model of Wistar albino rats. Indian J Exp. Biol. 2009; 47:182.
 67. Sudharaneshwari KR. Antibacterial screening of *Aegle marmelos* Lawsonia inermis and *Albizia libbeck*. Afr. J Tradit. Complement Altern. Med. 2007; 4(2):199-204.
 68. Kruawan K, Kangsadalampai K. Antioxidant activity phenolic compound contents and anti-mutagenic activity of some water extract of herbs. Thai. J Pharma. Sci. 2006; 30:1-47.
 69. Jagetia G, Venkatesh P, Baliga M. Evaluation of the radioprotective effect of bael leaf (*Aegle marmelos*) extract in mice. Int J Radiat Biol. 2004; 80(4):281-290.
 70. Jagetia GC, Venkatesh P, Baliga MS. Fruit extract of *Aegle marmelos* protects mice against radiation-induced lethality. Integr. Cancer Ther. 2004; 3:323.
 71. Veerappan A, Miyazaki S, Kadarkaraisamy M, Ranganathan D. Acute and subacute toxicity studies of *Aegle marmelos* Correa, an Ind. Med. plant. Phytomed. 2007; 14:209-215.
 72. Tamizhazhagan V, Pugazhendy K. Ethnobotanical and Phytopharmacological review of *Pisonia Alba* Span. Asian J Pharm Clin Res. 2017; 10(5):69-71.
 73. Tamizhazhagan V, Pugazhendy K, Sakthidasan V, Jayanthi C. Antioxidant properties of *Pisonia Alba* plant leaf extract. International Journal of Zoology and Applied Biosciences. 2017; 2(6):311-314.
 74. Sathiyaraj K, Sivaraj A, Madhumitha G, Kumar PV, Saral AM, et al. Antifertility effect of aqueous leaf extract of *Aegle marmelos* on male albino rats. International Journal of Current Pharmaceutical Research. 2010; 2(1):26-9.
 75. Rana BK, Singh UP, Taneja V. Antifungal activity and kinetics of inhibition by essential oil isolated from leaves of *Aegle marmelos*. Journal of ethno pharmacology. 1997; 57(1):29-34.
 76. Singanan V, Singanan M, Begum H. The hepatoprotective effect of bael leaves (*Aegle marmelos*) in alcohol induced liver injury in albino rats. International Journal of Science & Technology. 2007; 2(2):83-92.
 77. Baliga MS, Thilakchand KR, Rai MP, Rao S, Venkatesh P. *Aegle marmelos* (L.) Correa (Bael) and its phytochemicals in the treatment and prevention of cancer. Integrative cancer therapies. 2013; 12(3):187-196.
 78. Jagetia GC, Venkatesh P, Baliga MS. *Aegle marmelos* (L.) Correa inhibits the proliferation of transplanted Ehrlich ascites carcinoma in mice. Biol Pharm Bull. 2005; 28:58-64.
 79. Mazumder R, Bhattacharya S, Mazumder A, Pattnaik AK, Tiwary PM, Chaudhary S. Antidiarrhoeal evaluation of *Aegle marmelos* (Correa) Linn. Root extract. Phytother Res. 2006; 20(1):82-84.
 80. Gutiérrez SP, Sánchez MA, González CP, García LA. Antidiarrhoeal activity of different plants used in traditional medicine. Afr J Biotechnol. 2007; 6(25):2988-2994.
 81. Dhuley J. Investigation on the gastroprotective and antidiarrhoeal properties of *Aegle marmelos* unripe fruit extract. Hindustan, Antibiot Bull 2003; 45-46(1-4):41-46.
 82. Brijesh S, Daswani P, Tetali P, Antia N, Birdi T. Studies on the anti diarrhoeal activity of *Aegle marmelos* unripe fruit: validating its traditional usage. BMC Complement Altern Med. 2009; 9(1): 47.
 83. Dhankhar S, Ruhil S, Balhara M, Dhankhar S, Chhillar A. *Aegle marmelos*. (Linn.) Correa: A potential source of phytomedicine. J Med Plant Res. 2011; 5(9):1497-1507.
 84. Rojas R, Bustamante B, Bauer J, Fernández I, Albán J, Lock O. Antimicrobial activity of selected Peruvian medicinal plants. J Ethno pharmacology. 2003; 88(2):199-204.
 85. Duraipandiyar V, Ayyanar M, Ignacimuthu S. Antimicrobial activity of some ethno medicinal plants used by Paliyar tribe from Tamil Nadu, India. BMC Complement Altern Med. 2006; 6(1):35.
 86. Parekh J, Chanda SV. *In vitro* antimicrobial activity and phytochemical analysis of some Indian medicinal plants. Turk J Biol. 2007; 31(1):53-58.
 87. Venkatesan D, Karunakaran M, Kumar SS, Palaniswamy P, Ramesh G. Antimicrobial activity of *Aegle marmelos* against pathogenic organism compared with control drug. Ethnobotanical Leaflets. 2009; 13:968-974.
 88. Jyothi KS, Rao BS. Antibacterial activity of extracts from *Aegle marmelos* against standard pathogenic bacterial strains. Int J Pharm Tech Res. 2010; 2(3):1824-1826.
 89. Badam L, Bedekar S, Sonawane KB, Joshi SP. *In vitro* antiviral activity of bael (*Aegle marmelos* Corr) upon human coxsackieviruses B1-B6. J Commun Dis 2002; 34(2):88-99.
 90. Balasubramanian G, Sarathi M, Kumar SR, Hameed AS. Screening the antiviral activity of Indian medicinal plants against white spot syndrome virus in shrimp. Aquaculture 2007; 263(1-4):15-19.
 91. Baliga MS, Bhat HP, Pereira MM, Mathias N, Venkatesh P. Radioprotective effects of *Aegle marmelos* (L.) Correa (Bael): a concise review. J Altern Complement Med 2010; 16(10):1109-1116.
 92. Jagetia G, Venkatesh P, Baliga M. Evaluation of the radioprotective effect of bael leaf (*Aegle marmelos*) extract in mice. Int J Radiat Biol 2004; 80(4):281-290.
 93. Jagetia GC, Venkatesh P. Radioprotection by oral administration of *Aegle marmelos* (L.) Correa *in vivo*. J Environ Pathol Toxicol Oncol 2005; 24(4):315-332.
 94. Devasagayam T, Tilak J, Boloor K, Sane K, Ghaskadbi S, Lele R. Free radicals and antioxidants in human health: current status and future prospects. J Assoc Physicians India. 2004; 52:794-804.
 95. Agrawal SS, Kumar A, Gullaiya S, Dubey V, Nagar A, Tiwari P, et al. Antifertility activity of methanolic bark extract of *Aegle marmelos* (L.) in male wistar rats. Daru. 2012; 20(1):94.
 96. Sharmila S, Vasundra Devi PA. Comparison of *in vitro* antioxidant activity of the ethanolic extract of ripe and unripe fruit of *Aegle marmelos*. J Pharm. Res. 2011; 4:720-722.

97. Rajan S, Gokila M, Jency P, Brindha P, Sujatha RK. Antioxidant and phytochemical properties of *Aegle marmelos* fruit pulp. Int J Curr Pharm Res. 2011; 3(2):65-70.
98. Gheisari HR, Amiri F, Zolghadri Y. Antioxidant and antimicrobial activity of Iranian Bael (*Aegle marmelos*) fruit against some food pathogens. Int J Curr Pharm Res. 2011; 3(3):85-88.
99. Tamizhazhagan V, Pugazhendy K, Sakthidasan V, Jayanthi C. Preliminary screening of phytochemical evaluation selected plant of *Pisonia Alba*. IJ Biol. Research. 2017; 2(4):63-66.
100. Shoba FD, Thomas M. Study of anti diarrhoeal activity of four medicinal plants in castor oil induced diarrhea. Journal of Ethan olo pharmacology. 2001; 76(1):73-76.
101. Sharma PK, Bhatia V, Bansal N, Sharma A. A review on bail tree. Natural Product Radiance. 2007; 6(2):171-178.