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Nutritional properties of *Aegle marmelos* and its uses in Pharmacology

Akriti Verma**Abstract**

Aegle marmelos also known as 'Bael' which is considered as the therapeutic herb and it belongs to the Rutaceae family. Throughout its whole life, the bark, root, leaves, and fruit of this tree have therapeutic properties and have been utilized for a very long time in traditional medicine. *Aegle Marmelos* has a variety of distinct constituents, including terpenoids, alkaloids, vitamins, coumarin, tannins, carbohydrates, flavonoids, fatty acids, and essential oils. Numerous pharmacological characteristics are also possessed by the plant, such as Hepatoprotective, anti-diabetic activity, anti-cancer activity, cardio protective activity, anti-bacterial activity, antioxidant activity anti-inflammatory, anti-arthritis, anti-hyperlipidemic. In addition, it has antiviral, anti-ulcer, immunomodulatory, and wound healing properties and anti-proliferative properties. Therefore, the aim of this abstract is to investigate the nutritional and pharmacological benefits of some crude extracts *Aegle Marmelos* fruit.

Keywords: *Aegle marmelos*, pharmacological activity, nutritional properties

Introduction

Aegle marmelos has been identified as the healthiest organic product and is a subtropical plant. (Sharma *et al.*, 2006) [39]. It is around 6-8 meters in height. (Pandey *et al.*, 2020) [2]. *Aegle Marmelos* fruit has a round or oval form and ranges in diameter from 5 to 20 cm. *Aegle Marmelos* has a hard, woody shell with thick, aromatic pulp within that has been covered in a thick, transparent, slimy mucilage. (Mali *et al.*, 2020) [3]. In comparison to other fruits, it has a sweet taste and is highly nutritious. (Sarkar *et al.*, 2020) [4]. *Aegle Marmelos* is regarded as the source of its therapeutic and nutritional characteristics. Herbs, with their various phytochemical and bioactive constituents, are frequently used as cures for a number of illnesses, including diabetes, hypertension, cardiovascular disease, and other health-related issues. Almost every component of the *Aegle Marmelos* plant, including the leaves, roots, bark, and seeds, has been utilised for a long time in Ayurvedic treatment *Aegle Marmelos* is an essential food because it includes important oils, polysaccharides, gums, coumarins, alkaloids, and resins. These phytochemicals are beneficial for treating a number of illnesses, including ulcerative colitis, hypoglycemia, digestion aids, antifungals, antipyretics, and wound healing (Singh *et al.*, 2021) [5]. *Aegle Marmelos* varieties are cultivated in Goma Yashi, Thar Divya, Thar Neelkanth, Pant Shivani, Pant Aparna, Pant Urvashi, Pant Sujata, Kagzi Gonda, Kagzi Etawah, Narendra Bael-5 (NB-5), NB-7, NB-9, NB-16, NB-17, and Pant Shivani (Pandey *et al.*, 2020) [2]. In addition to developing in India, it is also produced in Southeast Asian nations such as Sri Lanka, Pakistan, Bangladesh, Burma, Thailand, and Uttar Pradesh, Uttaranchal, Jharkhand, and Rajasthan. [Bhardwaj *et al.*, 2015] [6].

Taxonomy of *Aegle Marmelos*

Aegle Marmelos fruit classified as belonging to the kingdom Plantae and the division of Magnoliophyta [Dhakar *et al.*, 2019] [7]. The herbs of *Aegle Marmelos* belongs to the family of Rutaceae and subfamily of Aurantioideae and Spindales is the order of *A. marmelos*, Genus of *Aegle* and Species of *Marmelos* [Behera *et al.*, 2014] [8] and [Srivastava *et al.*, 2022] [9]. It is also divided into Tribe and Subtribe of Aurantieae and Balsamocitrinae [Subedi *et al.*, 2022] [10].

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Table 1: Taxonomical classification of *Aegle Marmelos* [Dhakar *et al.*, 2019] ^[7]; [Behera *et al.*, 2014] ^[8] and [Subedi *et al.*, 2022] ^[10]

| | |
|-----------|-----------------|
| Kingdom | Plantae |
| Division | Magnoliophyta |
| Family | Rutaceae |
| Subfamily | Aurantioidae |
| Order | Spindales |
| Genus | Aegle |
| Species | Marmelos |
| Tribe | Aurantieae |
| Subtribe | Balsamocitrinae |

Nutritional and phytochemical properties of *Aegle marmelos*:

A nutritional perspective of *Aegle Marmelos*, herbs of *Aegle Marmelos* rich in moisture (61.6±0.07), Ash (1.29±0.05) energy (138±5), fiber (2.78±0.11), as well as good amount of carbohydrate (34.35±1.05), protein (1.87±0.16%), and fat (0.28±0.03) in small amount including Linoleic, Linolenic, oleic, Mystric, Palmitic and unsaturated fat along with 55µg Vitamin-A, 12mg Vitamin B₁, 1200 mg Vitamin B₂, 1.3mg Vitamin B₃, 8mg Vitamin C and Minerals (1.7%) such as Calcium (80mg), Phosphorus (52 mg) and Potassium (610 mg) [Shashank *et al.*, 2018] ^[11]; [Singh *et al.*, 2012] ^[12]. It also contain coumarins, oil, polysaccharides and gums [Chhetri *et al.*, 2021] ^[13].

Table 2: Chemical composition of *Aegle Marmelos*

| Chemical constituents | Parameters (per 100gm) | References |
|-----------------------|------------------------|--|
| Moisture (gm) | 56.91 – 64.2 | Shashank <i>et al.</i> , 2018 ^[11] ; Vv <i>et al.</i> , 2018 ^[14] ; Sarkar <i>et al.</i> , 2021 ^[15] ; Kaur <i>et al.</i> , 2017 ^[16] ; Singh <i>et al.</i> , 2014 ^[17] ; Ullikashi <i>et al.</i> , 2017 ^[18] ; Zehra <i>et al.</i> , 2015 ^[19] |
| Ash (gm) | 2.32 | |
| Protein (gm) | 1.6 – 3.64 | |
| Fat (gm) | 0.2 – 0.47 | |
| Energy (Kcal) | 137 -138 | |
| Fiber (gm) | 2.9 – 5.79 | |
| Minerals (mg) | 1.7 | |
| Vitamin A (mg) | 55 | |
| Thiamin (mg) | 0.12 – 1.2 | |
| Riboflavin (mg) | 0.18 – 1.2 | |
| Niacin (mg) | 0.87 – 1.1 | |
| Vitamin C (mg) | 8-60 | |

Aegle Marmelos has a variety of phytoconstituents in good concentrations in Table 2 lists some more phytochemical substances [Hazra *et al.*, 2020] ^[20]. Tannic acid ranges from 2.81 to 4.84 g, polyphenol concentration in *Aegle Marmelos* fruit ranges from 5.21% to 5.99% [Pathirana *et al.*, 2020] ^[21] and the total phenolic content was calculated to be 10.6 mg GAE/g [Wali *et al.*, 2016] ^[22]. Furthermore, marmelosin in A.

marmelos powder ranged from 415.75 to 737 µg/g. According to a study, A. marmelos contains several phenolic compounds with the following names: protocatechuic acid (47.9µg/g), gallic acid (873.6µg/g), ellagic acid (248.5µg/g), chlorogenic acid (136.8µg/g), and rutin (32.25 – 59.90). The overall flavonoid concentration is 1.16g CE/100g [Sharma *et al.*, 2022] ^[23].

Table 3: Phytochemical components of *Aegle Marmelos* (per 100 g)

| Class of phytochemical | Phytochemical components | Amount | References |
|------------------------|----------------------------|---------------|--|
| Polyphenol | Total phenolic content | 16.23-25.14 | [Sharma <i>et al.</i> , 2022] ^[23, 24] ; [Gurjar <i>et al.</i> , 2019]; [Venthodika <i>et al.</i> , 2020] ^[25] ; [Kaur <i>et al.</i> , 2017] ^[16] |
| | Tannin (g/100g) | 0.2-4.84 | |
| | Marmelosin (µg/g) | 415.75-737 | |
| | Ellagic acid (µg/g) | 248.5 | |
| | Chlorogenic acid (µg/g) | 136.8 | |
| | Gallic acid (µg/g) | 873.6 | |
| | Ferulic acid (µg/g) | 98.3 | |
| | Oxalate (g/100g) | 0.96 | |
| Flavoniod (mg/100g) | Protocatechuic acid (µg/g) | 47.9 | |
| | Total flavonoid content | 9.74-18.17 | |
| Carotene (µg/100g) | Rutin | 32.25-59.90 | |
| | α - carotene | 42.76-1698.22 | |
| | β - carotene | 51.67-153.43 | |
| | γ - carotene | 18.43-467.17 | |
| | δ - carotene | 43.73-45.03 | |

Pharmacological Activities

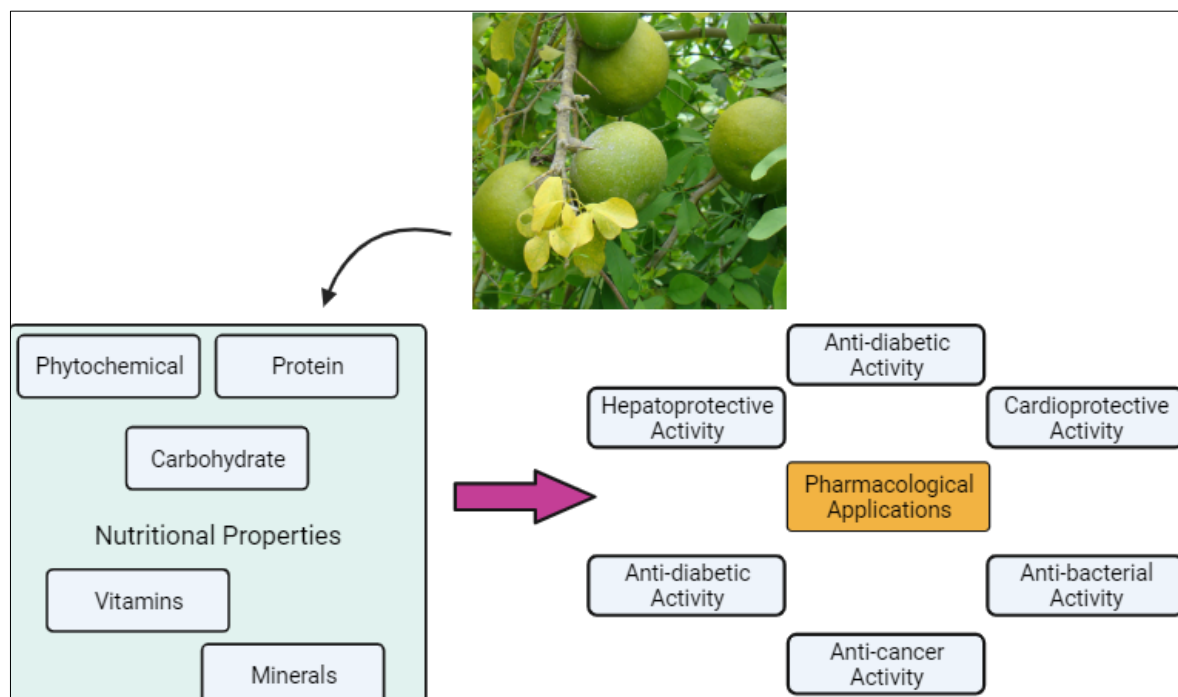


Fig 1: Nutritional and Pharmacological activity of *Aegle Marmelos*

Hepatoprotective activity

Hepatoprotective properties of an ethanolic extract of *Aegle Marmelos* leaf extract in albino rats with liver injury produced by CCL₄. The results of the study demonstrated the hepatoprotective potential of *Aegle Marmelos* leaf extract at a dose of 50 mg/kg [Rathee *et al.*, 2018] [26]. The hepatic damage biomarkers in serum samples and the pro- and anti-inflammatory cytokines in liver homogenates were determined by the *A. marmelos* leaf extract. The oxidative stress biomarkers included malondialdehyde, reduced glutathione, glutathione reductase, glutathione peroxidase, glutathione-S-transferase, superoxide dismutase, and catalase [Singh *et al.*, 2008]. Rats and mice that had been given bael at dosages of 25 and 50 mg/kg for seven days were induced in a study using carbon tetrachloride (CCl₄). There have also been seen decreased levels of xanthine oxidase, lipoprotein X (LPx), and serum toxicity marker enzymes (SGOT, LDH, and SGPT), indicating the hepatoprotective action of *Aegle Marmelos* [Khan *et al.*, 2009] [28].

Anti-diabetic Activity

The majority of people suffer from diabetes, a metabolic condition for which there is no known cure. Regarding to this illness, the *Aegle Marmelos* plant facilitates glucose absorption by a process similar to insulin therapy. *Aegle Marmelos* fruit aqueous extract was utilised to decrease the effects of streptozotocin-induced hypoglycemia in diabetic rats (STZ). Oral administration of alcoholic extracts has been demonstrated to reduce blood sugar levels in rabbit models. According to a study, callus and leaf extracts can stimulate the cells in the pancreas that secrete insulin. Methanol extracts of callus and leaves offer the strongest anti-diabetic effects, while other extracts can also be used [Bahera *et al.*, 2014] [8]. Aqueous extract of *A. marmelos* leaf were taken and investigate on adult male Swiss Albino rats and were found to inhibit glucose uptake in rat inverted intestinal sacs.

Methanolic extract of leaves of *A. marmelos* given to alloxan diabetic rats, Blood sugar level found to be decreased from 6th day of administration while on 12th day sugar level comes to 44% [Sekar *et al.*, 2011] [29].

Anti-cancer activity

According to a study, *A. marmelos* can stop tumor cells, erythroleukemic HEL, melanoma cato38, MDAMB-23, and breast cancer MCFT cell lines from growing *in vitro* [Jhahria *et al.*, 2016] [30]. Extracts from *A. marmelos* could successfully suppress the leukemic K562, T-lymphoid Jurkat, B-lymphoid, and Erythro leukemic HEL20 [Sajjan *et al.*, 2022] [31]. The compound 1-hydroxy-5, 7-dimethoxy-2-naphthalene-carboxaldehyde, or marmelin, is present in *Aegle Marmelos* and inhibits the growth of epithelial cancer cells. (Colon HCT-116 cells and Alveolar Epithelial Cancer cells, HEP-2). TNF- α , TNFR1, and TRADD mRNA and protein expression are produced by marmelin. G1 cell cycle arrest was followed by a caspase-3-initiated apoptosis that was reversed upon pretreatment with a caspase-3 restricter also resulted in the activation of caspase-8 and bid with released cytochrome, suggesting that the death receptor and the mitochondrial pathway are in communication [Rahman *et al.*, 2014] [32]. Leaf extracts from *Aegle Marmelos* may successfully suppress the leukemic K562, T-lymphoid Jurkat, and B-lymphoid Raji. [Baliga *et al.*, 2011] [33].

Anti-bacterial activity

Methanolic extract of *Aegle Marmelos* fruit has shown considerable effect against the salmonella typhi bacterium and has a lower inhibitory concentration than the aqueous extract. The antibacterial activity of leaf extract is identified by the presence of eugenol and cuminaldehyde. The antibacterial properties of *Aegle Marmelos* may prevent protein production at the transcription and translation stages [Jhahria *et al.*, 2016] [30]. Bacteria that cause disease in organisms typically

spread through food, soil, water, and air. Other similar types of diseases can be treated with natural therapies [Kumar *et al.*, 2021] ^[34].

Antioxidant activity

Naturally existing substances called antioxidants aid in the elimination of harmful substances like free radicals that are produced during excessive oxidation. Flavonoids, flavens, isoflavones, coumarin, anthocyanin, catechins, isocatechins, anthocyanins, and ligans are among the phytochemicals present in the pulp of *A. marmelos* that provide antioxidant properties and protect the plant from harmful compounds [Rasool *et al.*, 2022] ^[35]. Through the process of scavenging free radicals, antioxidant chemicals protect the cell against oxidative stress. High antioxidant concentration aids in the breakdown of numerous harmful substances, including free radicals [Lomate *et al.*, 2021] ^[36].

Cardio-protective activity

According to a study, unripe *A. marmelos* fruit may be utilized to treat cardiac conditions, while fresh *A. marmelos* juice is suggested to be more palatable, less poisonous, and cardiotoxic in the heart of a separated frog. Meta-analytic Research suggests that utilizing the polyherbal Tibetan medicine Padma28, which contains extract from *A. marmelos*, may be beneficial for people suffering from peripheral artery disease [Bobade *et al.*, 2020] ^[37]. Leaf extract from *A. marmelos* increases the activity of creatine kinase and lactate dehydrogenase and decreases the amount of rats treated with isoprenaline59. It has also been reported that the leaf extract from *A. marmelos* is used as a cardiac depressant and to treat palpitations. [Vispute *et al.*, 2023] ^[38].

Conclusion

The nutritional properties and pharmacological potential of *Aegle Marmelos* is revealed in this review article. Since *Aegle Marmelos* have a wide range of pharmacological and phytochemical properties. This study also demonstrates the fruit, leaves, bark, and seeds of *Aegle Marmelos* have extractable phytochemicals and bioactive with a wide range of health benefits. The discussion above indicates that the fruits, seeds, bark, and leaves of *Aegle Marmelos* possess a number of phytochemical and pharmacological properties that need further research in order to generate pharmaceutical products.

References

1. Sharma PC, Bhatia V, Bansal N, Sharma A. A review on Bael tree; c2007.
2. Pandey D, Misra AK, Garg N. Production, Protection and Processing of Bael. 2020.
3. Mali SS, Dhumal RL, Havaldar VD, Shinde SS, Jadhav NY, Gaikwad BS. A systematic review on *Aegle Marmelos* (Bael). Research Journal of Pharmacognosy and Phytochemistry. 2020;12(1):31-36.
4. Sarkar T, Salauddin M, Chakraborty R. In-depth pharmacological and nutritional properties of Bael (*Aegle Marmelos*): A critical review. Journal of agriculture and food research. 2020;2:100081.
5. Singh AK, Singh S, Saroj PL, Singh GP. Improvement and production technology of bael (*Aegle Marmelos*) in India-a review. Current Horticulture. 2021;9(1):3-14.
6. Bhardwaj RL, Nandal U. Nutritional and therapeutic potential of bael (*Aegle Marmelos* Corr.) fruit juice: a

- review. Nutrition & Food Science; c2015. [https://doi.org/10.1108/NFS-05-2015-0058]
7. Dhakar MK, Das B, Nath V, Sarkar PK, Singh AK. Genotypic diversity for fruit characteristics in bael [*Aegle Marmelos* (L.) Corr.] based on principal component analysis. Genetic Resources and Crop Evolution. 2019;66(4):951-964. [https://doi.org/10.1007/s10722-019-00757-x].
8. Behera P, Raj VJ, Prasad AB, Basavaraju R. A review on phytochemical and pharmacological values of fruit pulp of *Aegle Marmelos*. Global Journal of Research on Medicinal Plants & Indigenous Medicine. 2014;3(9):339.
9. Srivastava AK, Singh VK. Anti-Fertility Role of *Aegle Marmelos* (Bael). Journal of Applied Health Sciences and Medicine. 2022;2:21-25.
10. Subedi A, Bashyal B. Medicinal properties and uses of *Aegle Marmelos* (Bel) plant: A review. Asian Journal of Pharmacognosy. 2022;6(1):10-20.
11. Shashank A. Importance and value addition of Bael (*Aegle Marmelos*) fruit; c2018.
12. Singh U, Kocher A, Boora R. Proximate composition, available carbohydrates, dietary fibres and anti-Nutritional factors in Bael (*Aegle Marmelos* L.) leaf, pulp and seed powder. International Journal of Scientific and Research Publications. 2012;2(4):1-4.
13. Chhetri S, Kundu S, Tamang A, Mahato S, Mahato A. The Bael (*Aegle Marmelos* L. Corr.): Health Benefits and its varietal wealth. Environment and Ecology. 2021;39(4A):1355-1361.
14. Uttarwar VV, Taur AT, Sawate AR. Studies on evaluation of physicochemical and nutritional properties of bael fruit (*Aegle Marmelos*). Journal of Pharmacognosy and Phytochemistry. 2018;7(3):547-549.
15. Sarkar A, Rashid M, Musarrat M, Billah M. Phytochemicals and Nutritional Constituent Evaluation of Bael (*Aegle Marmelos*) Fruit Pulp at Different Development Stage. Asian Food Science Journal. 2021;20:78-86. [https://doi.org/10.9734/afsj/2021/v20i130257].
16. Kaur A, Kalia M. Physico chemical analysis of bael (*Aegle Marmelos*) fruit pulp, seed and pericarp. Chemical Science Review and Letters. 2017;6(22):1213-1218.
17. Singh AK, Chakraborty I, Chaurasiya AK. Bael preserve-syrup as booster of human health as a health drink. The Bioscan. 2014;9(2):565-569.
18. Ullikashi KY, Kammar MR, Lokapure SR. Development of value-added products from bael fruit (*Aegle Marmelos*). Int. J Current Micro and Appli. Sci. 2017;6:26522659. [https://doi.org/10.20546/ijcmas.2017.607.374].
19. Lakht-e-Zehra A, Dar NG, Saleem N, Soomro UA, Afzal W, Naqvi B, *et al.* Nutritional exploration of leaves, seed and fruit of bael (*Aegle Marmelos* L.) grown in Karachi region. Pak. J Biochem. Mol. Biol. 2015;48(3):61-65.
20. Hazra SK, Sarkar T, Salauddin M, Sheikh HI, Pati S, Chakraborty R. Characterization of phytochemicals, minerals and *in vitro* medicinal activities of bael (*Aegle Marmelos* L.) pulp and differently dried edible leathers. Heliyon. 2020;6(10):se05382. [https://doi.org/10.1016/j.heliyon.2020.e05382].
21. Pathirana CK, Madhujith T, Eeswara J. Bael (*Aegle Marmelos* L. Corrêa), a medicinal tree with immense economic potentials. Advances in Agriculture; c2020. p.

- 1-13. [<https://doi.org/10.1155/2020/8814018>].
22. Wali A, Gupta M, Mallick SA, Gupta S, Jaglan S. Antioxidant Potential and Phenolic Contents of Leaf, Bark And Fruit Of *Aegle Marmelos*. Journal of Tropical Forest Science; c2016. p. 268-274. [<https://www.jstor.org/stable/43856531>].
23. Sharma N, Kumar M, Zhang B, Kumari N, Singh D, Chandran D, et al. *Aegle marmelos* (L.) Correa: An Underutilized Fruit with High Nutraceutical Values: A Review. International Journal of Molecular Sciences. 2022;23(18):10889. [<https://doi.org/10.3390/ijms231810889>].
24. Gurjar PS, Bhattacharjee AK, Singh A, Dikshit A, Singh VK. Characterization of nutraceuticals in bael powder prepared from fruits harvested at different developmental stages. Indian Journal of Traditional Knowledge. 2019;18:724-730.
25. Venhodika A, Chhikara N, Mann S, Garg MK, Sofi SA, Panghal A. Bioactive compounds of *Aegle Marmelos* L., medicinal values and its food applications: A critical review. Phytotherapy Research. 2021;35(4):1887-1907. [<https://doi.org/10.1002/ptr.6934>].
26. Rathee D, Kamboj A, Sidhu S. Augmentation of hepatoprotective potential of *Aegle Marmelos* in combination with piperine in carbon tetrachloride model in wistar rats. Chemistry Central Journal. 2018;12:1-13.
27. Singh R, Rao HS. Hepatoprotective effect of the pulp/seed of *Aegle marmelos* correa ex Roxb against carbon tetrachloride induced liver damage in rats. International Journal of Green Pharmacy (IJGP), 2008, 2(4).
28. Khan TH, Sultana S. Antioxidant and hepatoprotective potential of *Aegle Marmelos* Correa. Against CCl₄-induced oxidative stress and early tumor events. Journal of Enzyme Inhibition and Medicinal Chemistry. 2009;24(2):320-327.
29. Sekar DK, Kumar G, Karthik L, Rao KB. A review on pharmacological and phytochemical properties of *Aegle marmelos* (L.) Corr. Serr. (Rutaceae). Asian Journal of Plant Science and Research. 2011;1(2):8-17.
30. Jhahria A, Kumar K. Tremendous pharmacological values of *Aegle Marmelos*. International Journal of Pharmaceutical Sciences Review and Research. 2016;36(2):121-127.
31. Sajjan ST. A Review paper on various plants are used in various types of diseases. International Journal of Advanced Research in Science, Communication and Technology. 2022;2(5):447-459. [DOI: 10.48175/IJARSCT-4837].
32. Rahman S, Parvin R. Therapeutic potential of *Aegle Marmelos* (L.)-An overview. Asian Pacific journal of tropical disease. 2014;4(1):71-77.
33. Baliga MS, Bhat HP, Joseph N, Fazal F. Phytochemistry and medicinal uses of the bael fruit (*Aegle marmelos* Correa): A concise review. Food Research International. 2011;44(7):1768-1775.
34. Kumar KS, Suresh K, Pohita E. Review on Pharmacognostic and Pharmacological Activities of *Aegle Marmelos*: A sacred Plant. Journal of Pharmaceutical Advanced Research. 2021;4(12):1428-1432.
35. Rasool SPG, Dehghan H A comprehensive review on medicinal plant: *Aegle marmelos* (Linn) correa. European Journal of Pharmaceutical and Medical Research. 2022;9(3):193-203.
36. Lomate KA, Murthy K, Adak VS, Shete RV. A review on phytochemical and pharmacological values of *Aegle Marmelos*. Journal of Drug Delivery and Therapeutics. 2021;11(2-S):162-166. [<https://doi.org/10.22270/jddt.v11i2-S.4645>].
37. Bobade H, Sharma S, Singh A. Indian Bael. Antioxidants in Fruits: Properties and Health Benefits; c2020. p. 135-161. [DOI: 10.1007/978-981-15-7285-2_8].
38. Vispute MYM, Thosar MN, Chavarkar MP. Bael Patra as Anti-Oxidant: A Review. International Journal for Research in Applied Science & Engineering Technology. 2023;11(1):743-750. [<https://doi.org/10.22214/ijraset.2023.48668>].
39. Sharma RK, Agrawal M, Marshall F. Heavy metal contamination in vegetables grown in wastewater irrigated areas of Varanasi, India. Bulletin of Environmental Contamination & Toxicology. 2006 Aug 1;77(2).