



Ziziphus mauritiana Seeds: Tiny Treasures of Wellness

¹Padmal Sudhakar Patil, ²Vaishali V Potnis,

¹M. Pharm Research Scholar, ²Principal

^{1,2}Department of Pharmaceutics,

^{1,2}JSPM'S Jaywantrao Sawant college of Pharmacy and Research, Hadapsar, Pune, India

Abstract: *Ziziphus mauritiana*, commonly known as ber or Indian jujube, is a fruit with a rich history of medicinal use. Despite its widespread popularity and documented health benefits, its seeds have often been overlooked and underutilized. This review explores the diverse uses of *Ziziphus mauritiana* seeds, ranging from traditional medicine to modern research applications. The seeds exhibit potential as an adsorbent for dye removal and possess hypnotic, anticancer, and hypoglycemic properties. Additionally, they are rich in nutrients and minerals, making them a valuable resource with promising applications in pharmaceuticals, nutraceuticals, and skincare products. The future perspectives of *Ziziphus mauritiana* seeds are bright, with potential implications for addressing food insecurity, healthcare challenges, and environmental issues. Further research and exploration are warranted to fully harness the potential of these seeds and unlock their benefits for humanity.

IndexTerms - *Ziziphus mauritiana*, ber, Indian jujube, seeds, traditional medicine, medicinal properties, adsorbent, hypnotic, anticancer, hypoglycemic, nutraceuticals, skincare, future perspectives.

1. INTRODUCTION

Ber (*Ziziphus mauritiana* L.), is called as poor man's apple. It is one of the most ancient and common fruit's indigenous to India, belongs to the family Rhamnaceae [1]. "BAU Kul" is another name for *Ziziphus mauritiana* and is a newly improved fast-growing variety of plum and sweet seasonal fruit which is very popular [2]. Ber is popular due to high economic returns, low cost of cultivation wider adaptability and ability to withstand drought [1]. Various parts of *Ziziphus mauritiana* have also been reported for immunomodulatory, antioxidant, anticancer, anti-diarrhoeal, hypoglycemic, hypolipidemic, antiulcer, antimicrobial, and antiparasitic activities. However, despite the medicinal properties of *Ziziphus mauritiana*, its seed is less explored, underutilized and are often discarded as a waste [3]. According to "Shen Nong's Herbal Classic" records, its fruit can treat sleeplessness, pain above and below the umbilicus, sweating, and polydipsia. It can also tonify the liver, make the ribs strong, nourish the yin, and make us fat. In recent years, pharmacological researchers found that *Z. jujuba* Mill. contains various bioactive compounds, such as polysaccharides, flavonoids, saponins, triterpenoids, alkaloids, and tannins, which have several health benefits [5]. It is one of the richest sources of Vitamin C, next to aonla and guava but better than citrus fruits and apple. Ber is also designated as "King of Arid fruits" owing to the fact that it can be grown in unproductive, waste, marginal or inferior soil with pH as high as 9.0 in arid and semi-arid regions. Maturity is an integral component of quality, especially in the context of commercial maturity. On the other hand, Index is the sign or indication of the readiness of fruits for harvest according to consumer's choice. The time required for ber fruit to develop from fruit set to maturity is dependent on cultivar and location. Fruits that are allowed to ripen on the tree normally have a shorter shelf life and the best results are obtained if they are picked before the onset of ripening. Immature fruits do not have satisfactory sweetness and taste [7]. The genus *Ziziphus* (Rhamnaceae), comprises of approximately 170 species and 12 variants, and is distributed in the warm-temperate and subtropical regions throughout the world. Thirteen of which are distributed in the southern and eastern China. Most *Ziziphus* species are important sources for their edible fruits and medicinal uses [9]. The extracts from fruits, leaves, and seeds of *Ziziphus mauritiana* have been reported to exhibit antioxidant activity, whereas bark and pulp are reported to possess cytotoxicity against different cancer cell lines [10]. It has been used as a folk remedy for a long time for several ailments and diseases. A bark paste of the tree is applied on sores, the fruit as well as leaf extracts have been reported to exhibit antioxidant activity. Pisha et al. (1995) and Ramadoss et al. (2000) reported that the bark of *Z. mauritiana* possesses cytotoxic effect on tumor cell lines. The fruit has been reported as an immune stimulant in traditional Chinese medicine [11].

2. PLANT PROFILE

2.1. TAXONOMICAL PROFILE

Ziziphus mauritiana (*Z. mauritiana*) is a plant species belonging to the Rhamnaceae family. This family encompasses almost 900 species distributed across 58 genera. *Ziziphus* is a botanical genus consisting of approximately 40 species of thorny shrubs and petite trees within the Rhamnaceae family. These plants are distributed in warm temperate and subtropical regions across the globe. *Z. mauritiana* Lam. is a species of the *Ziziphus* genus. It is classified as follows: [16]

Domain	Eukaryota,
Kingdom	Plantae
Phylum	Spermatophyta
Sub-Phylum	Angiospermae
Class	Dicotyledonae
Order	Rhamnales
Family	Rhamnaceae
Genus	Ziziphus Mill
Species	Indain Jujube.

Table no 1: Taxonomical classification of *Zizyphus mauritiana*.

2.2. OCCURRENCE AND DISTRIBUTION

Z. mauritiana is primarily distributed in tropical regions of Africa (Algeria, Egypt, Kenya, Libyan Arab Jamahiriya, Tunisia, Uganda), South Asia (Afghanistan, Bangladesh, India, Nepal, Pakistan), Southeast Asia (Indonesia, Malaysia, Thailand, Vietnam), Australia, China. The genus *Ziziphus* includes many species found in India, Pakistan, Afghanistan, Iran, Europe, and America.^{2,26} *Z. mauritiana* is a shrub or cultivated fruit tree that has become subsontaneous in certain areas of Africa. It is native to Africa and has the widest distribution among all the *Ziziphus* species. It occupies a significant territory known as the “Sahelian or coastal zone.” The Sahelian or coastal zone, where *Z. mauritiana* thrives, stretches from the Atlantic (Senegal and Mauritania) to Somalia, encompassing regions as far as Arabia and India. This species is well-suited to the climate conditions found in this particular zone. The species is found in various regions of the Indian subcontinent, including Arunachal Pradesh, Bihar, the Himalayas, Jammu and Kashmir, Madhya Pradesh, Maharashtra, Meghalaya, Rajasthan, Sikkim, Uttar Pradesh, and the Thar Desert regions. It is also globally distributed in the Paleotropics, which encompasses warm-temperate, tropical, and subtropical regions. [16]

2.3. COMPOSITION OF ZIZYPHUS MAURITIANA SEEDS

Proximate component of the seeds of *Z. mauritiana* are presented in Table no 2. The protein content of the seeds is $36.10 \pm 0.57\%$ higher than *Amaranthus* sp. seeds which is 10.3 to 18.3%. *Digitaria exilis* (1.3%) and melon seed (33.8%) (Afam and Jacob, 1993) (Unfermented). The crude fibre contents and carbohydrate of *Z. mauritiana* are $11.04 \pm 0.88\%$ and $21.26 \pm 2.63\%$, respectively, and these are higher than fermented melon seed with crude fibre content of 2.4% and carbohydrates of 7.3%. The energy value of 100 g of the seeds containing 36.10 g of proteins, 27.4 g of lipids and 21.6 g of carbohydrates is 470.28 cal. (1967.66 Kj). This exceeds the energy content (value) of *Z. mauritiana* pericarp with only 1547.14 Kj/100 g. Children, ages 1 to 10 years (19.33 kg) required an average of 2267 Kj (Brown, 1989) of protein per day, that means, they need to take about 68.47 g of *Z. mauritiana* seeds, if an allowance of 25% digestibility and limiting sulphur amino acids are to be made.

Table no 3 showed that *Z. mauritiana* seeds contain higher amount of phosphorus than its fruit pericarp (Anthony and Effiong, 1998). Adult males weighing 66.60 kg required about 15 mg of zinc per day and this can be obtained from 0.426 kg of *Z. mauritiana* (Judith, 1990). For pregnant and lactating women, about 1200 mg of phosphorus is required per day. This implies that, they need to take about 0.2 kg of *Z. mauritiana* seed per day to maintain the recommended dietary allowances for phosphorus [14].

Content	Dry weight (g/100 g)
Moisture	4.21 ± 0.30
Ash	2.79 ± 0.27
Protein	36.10 ± 0.57
Crude fibre	11.04 ± 0.88
Lipids	27.40 ± 0.11
Carbohydrate	21.26 ± 0.63

Table no 2: Proximate composition (g/100 g dry weight) of *Zizyphus mauritiana* seeds. [14]

Content	Dry weight (mg/100 g)
Sodium (Na)	154.79 ± 10.50
Magnesium (Mg)	6.23 ± 0.12
Potassium (K)	589.08 ±10.69
Zinc (Zn)	3.52 ± 0.05
Manganese (Mn)	1.15 ± 0.14
Iron (Fe)	1.21 ± 0.15
Phosphorus (P)	585.43 ± 41.29

Table no 3: Mineral composition of the seeds of Ziziphus mauritiana (in mg/100 g). [14]



Fig no 1: Zizyphus mauritiana tree[17]

Fig no 2: Zizyphus mauritiana seeds[18]

3. PROPERTIES OF ZIZYPHUS MAURITIANA SEEDS

3.1. Zizyphus mauritiana seeds as adsorbent

Zizyphus mauritiana seeds show adsorption potential for cationic dye methylene blue, with equilibrium achieved in 180 minutes. The seeds were not chemically treated, indicating natural adsorption capabilities. Kinetic modeling revealed that the pseudo-second-order and Elovich models fit better than the pseudo-first-order model, indicating efficient adsorption kinetics. Surface properties were characterized using SEM, EDX, BET analysis, and FTIR, revealing the morphology, elemental composition, surface area, and functional groups of the adsorbent [4].

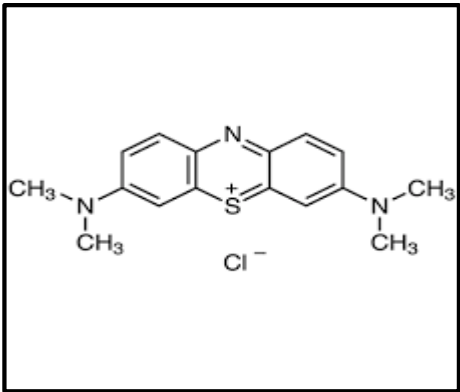


Fig no 3: Methylene Blue

3.2. Hypnotic property of Zizyphus mauritiana seeds

Zizyphus mauritiana seeds have been traditionally used for treating insomnia and anxiety, with popular use as sedative and hypnotic drugs in various Asian countries. The ethanolic extract from Z. mauritiana seeds demonstrated hypnotic activity by

increasing sleeping time in mice administered with sodium pentobarbital. This study supports the traditional use of *Z. mauritiana* seeds for insomnia treatment and suggests further development of these seeds as an alternative sedative and hypnotic product. The standardized extract of *Z. mauritiana* seeds could potentially be developed as an alternative sedative/hypnotic product, pending the identification of the major active components responsible for the hypnotic effect [8].

3.3. Anticancer property of *Zizyphus mauritiana* seeds

Zizyphus mauritiana seeds exhibit potent anticancer potential in vitro against various cell lines, including HL-60, Molt-4, HeLa, and normal cell line HGF, as demonstrated by MTT assay. The seed extract induces apoptosis in HL-60 cells in a dose-dependent manner, as evidenced by Annexin and PI binding assays. Treatment with *Zizyphus mauritiana* seed extract leads to DNA fragmentation in HL-60 cells, confirming its anticancer activity. In vivo studies on Ehrlich ascites carcinoma-bearing mice show that the seed extract significantly reduces tumor volume, viable tumor cell count, and enhances antioxidant status. The aqueous-ethanolic seed extract of *Zizyphus mauritiana* has been reported to exhibit anticancer activity against different cancer cell lines in vitro and Ehrlich ascites carcinoma in vivo [10].

3.4. Hypoglycemic property of *Zizyphus mauritiana* seeds

Zizyphus mauritiana seed extract contains betulinic acid, which showed hypoglycemic activity in animal studies. Administration of *Zizyphus mauritiana* seed extract at different doses (100, 400, 800 mg/kg) resulted in a significant reduction in blood glucose levels in diabetic mice. The combination of glyburide and *Zizyphus mauritiana* seed extract exhibited better reduction in glucose levels compared to glyburide alone. In diabetic mice, treatment with *Zizyphus mauritiana* seed extract at various doses led to changes in body weight over a 28-day period [11].

4. EXPLORING THE DIVERSE USES OF ZIZYPHUS MAURITIANA SEEDS

1. *Zizyphus mauritiana* seeds have various uses in traditional medicine and modern research. In traditional medicine, the seeds are used to treat heartburn, biliousness, astringency, scabies, diuretic, nausea, and during pregnancy to stop nausea, vomiting, and abdominal pains. [19]
2. They are also used in traditional Chinese medicine to manage sleeping disorders and anxiety. [19]
3. In Nigeria, the seeds are used to treat diarrhea, which is a leading cause of death in newborns. [19]
4. The seeds are also used in wound healing and to dress injuries. [19]
5. Modern research has also shown that *Zizyphus mauritiana* seeds have anti-cancer potential. The seed extract of *Zizyphus mauritiana* has shown anti-cancer potential in vitro against various cell lines [19].
6. The seeds are also rich in terpenoids, tannins, and flavonoids, which promote colonic absorption of water and electrolytes, and inhibit castor oil-induced prostaglandin synthesis, contributing to the anti-diarrheal effect of the seed and stem bark [20]
7. In addition to these uses, *Zizyphus mauritiana* seeds are also used in the production of skin care products to reduce redness and swelling, wrinkles and dryness, and for relief from sunburn
8. The seeds are also used in the production of various pharmaceutical and nutraceutical products [21].
9. *Zizyphus mau*. In traditional medicine, these seeds are utilized to manage, heartburn, biliousness, astringency, scabies, diuretic, and nausea [19]
10. They are also employed during pregnancy to alleviate symptoms like nausea, vomiting, and abdominal pains. [19]
11. Furthermore, in Nigeria, the seeds are used to address diarrhea, a significant cause of mortality in newborns. [19]
12. . Additionally, the seeds have anti-inflammatory properties and are rich in antioxidants, which can neutralize free radicals and potentially prevent chronic diseases [16].

5. FUTURE PERSPECTIVES

Future perspectives of *Zizyphus mauritiana* seeds encompass a broad range of applications, particularly in alleviating household food insecurity and addressing various health conditions. Research indicates that these seeds have the potential to contribute significantly to food security by providing essential nutrients and addressing nutritional deficiencies [22]. Additionally, the medicinal attributes and pharmacological activities of *Zizyphus mauritiana* seeds suggest promising prospects in the management of conditions such as asthma, diarrhea, dysentery, gingivitis, ulcers, and other inflammatory diseases [23]. The future perspectives of *Zizyphus mauritiana* seeds are promising, with potential applications in food security, healthcare, and disease management. Their diverse medicinal attributes, nutritional content, and pharmacological activities highlight the significance of further research and exploration to unlock their full potential in addressing various health challenges.

6. CONCLUSION

In conclusion, *Zizyphus mauritiana* seeds, often overlooked and underutilized, hold immense potential in various fields ranging from nutrition to healthcare. Their nutritional composition, coupled with their pharmacological properties, positions the seeds as a valuable resource with promising applications in various industries, including pharmaceuticals, nutraceuticals, and skincare. With continued scientific inquiry and innovation, *Zizyphus mauritiana* seeds have the potential to make significant contributions to improving health outcomes and enhancing quality of life worldwide.

7. REFERENCES

1. Amit Kumar, Dr. PKS Gurjar, Manoj Kumar Kureel, Amit Kumar and Anshul Asr. Effect of Pre-sowing seed treatments on root growth. Phytojournal.com.
2. Akanda MKM, Hasan AHMN. Characterization of pharmacological properties of methanolic seed and stem bark extracts of *Ziziphus mauritiana* (BAU Kul) using in-vitro and in-vivo animal (Swiss albino male mice) model. Clin Phytoscience. 2021;7(1).
3. Alawode AR, Iyaka AY, Ndamitso MM, Anuonye JC. *Ziziphus mauritiana* (jujube) seed as a protein source in the diet promote growth performance and stabilized hematology, lipid profile and serum chemistry profile of *Rattus norvegicus*. Adv Res Life Sci. 2020;4(1):1–10.
4. Singh H, Rana S, Mittal S. Experimental investigation and kinetic modeling of adsorption behaviour of inexpensive *Ziziphus mauritiana* seeds. Res.in. 2017.
5. Xia F-L, Cao H-W, Gao L-X, Qing-Kong, Mei-Li, Wang C-J, et al. Identification of *Ziziphi spinosae* semen from its adulterants based on RAPD. Pharmacogn Mag. 2023;19(3):763–71.
6. Kumar A, Gurjar DP, Kashyap DA, Mandloi V, Parteti A. Response of pre-sowing seed treatments on growth of Ber (*Zizyphus mauritiana* L.). Int J Chem Stud. 2020;8(2):2368–71.
7. Kumar A, Singh O, Kohli K. Seed development studies on the pattern of changes in seed physical attributes of ber (*Zizyphus mauritiana* Lamk.) cultivars under Tarai region. Int J Chem Stud. 2020;8(5):904–11.
8. San AMM, Thongpraditchote S, Sithisarn P, Gritsanapan W. Total phenolics and total flavonoids contents and hypnotic effect in mice of *Ziziphus mauritiana* lam. Seed extract. Evid Based Complement Alternat Med. 2013;2013:1–4.
9. Wang B, Zhu H-T, Wang D, Yang C-R, Xu M, Zhang Y-J. New spinosin derivatives from the seeds of *Ziziphus mauritiana*. Nat Products Bioprospect. 2013;3(3):93–8.
10. Mishra T, Khullar M, Bhatia A. Anticancer potential of aqueous ethanol seed extract of *Ziziphus mauritiana* against cancer cell lines and Ehrlich ascites carcinoma. Evid Based Complement Alternat Med. 2011;2011:1–11.
11. Bhatia A, Mishra T. Hypoglycemic activity of *Ziziphus mauritiana* aqueous ethanol seed extract in alloxan-induced diabetic mice. Pharm Biol. 2010;48(6):604–10.
12. Naz A, Raza N, Sharif M, Razzaq K, Ullah S, Afzal MI, et al. Performance evaluation of different grown ber (*Ziziphus mauritiana*) cultivars under low-temperature storage. Int J Food Prop. 2023;26(1):1736–48.
13. Venkateshwarlu M. Efficient protocol for the in vitro cloning of *Zizyphus mauritiana* L. Researchjournal.co.in. 2009.
14. B.I, Yerima & Adamu, Harami. (2011). Proximate chemical analysis of nutritive contents of Jujube (*Ziziphus mauritiana*) seeds. International Journal of the Physical Sciences. Vol. 6(36),. 10.5897/IJPS09.024.
15. *Ziziphus mauritiana* lam. Plants of the World Online.
16. Deepak Jha, Pallavi Hangargekar, Md Akbar, Ashish Singh Parihar, Saurabh Kashyap, Amol Joshi, Md Azizur Rahman, *Ziziphus mauritiana*: An in-depth review of its medicinal attributes and pharmacological activities, Intelligent Pharmacy, Volume 2, Issue 2, 2024, Pages 274-283, ISSN 2949-866X, <https://doi.org/10.1016/j.ipha.2023.12.001>. (<https://www.sciencedirect.com/science/article/pii/S2949866X23001272>)
17. Wikipedia contributors. *Ziziphus mauritiana*. Wikipedia, The Free Encyclopedia. 2024. Available from: https://en.wikipedia.org/w/index.php?title=Ziziphus_mauritiana&oldid=1219290572.
18. Indian jujube - (*Ziziphus jujube*) [Internet]. Amkha Seed. [cited 2024 Apr 22]. Available from: <https://www.amkhaseed.com/products/indian-jujube-ziziphus-mauritiana>
19. Alsayari A, Wahab S. Genus *Ziziphus* for the treatment of chronic inflammatory diseases. Saudi J Biol Sci. 2021 Dec;28(12):6897–6914. doi: 10.1016/j.sjbs.2021.07.076. Epub 2021 Jul 30. PMID: 34866990; PMCID: PMC8626254.
20. Akanda, M.K.M., Hasan, A.H.M.N. Characterization of pharmacological properties of methanolic seed and stem bark extracts of *Ziziphus mauritiana* (BAU Kul) using in-vitro and in-vivo animal (Swiss albino male mice) model. Clin Phytosci 7, 8 (2021). <https://doi.org/10.1186/s40816-020-00246-0>.
21. *Zizyphus*. RxList. [cited 2024 Apr 22]. Available from: <https://www.rxlist.com/supplements/zizyphus.htm>
22. Archive.org. [cited 2024 Apr 22]. Available from: <https://scholar.archive.org/work/5tydqvrhnb7peaapajslipyv4/access/wayback/https://journals.umt.edu.pk/index.php/SIR/article/download/1405/684>
23. Jha D, Hangargekar P, Akbar M, Parihar AS, Kashyap S, Joshi A, et al. *Ziziphus mauritiana*: An in-depth review of its medicinal attributes and pharmacological activities. Intelligent Pharmacy [Internet]. 2024;2(2):274–83. Available from: <http://dx.doi.org/10.1016/j.ipha.2023.12.001>.