Phytochemistry of *Ziziphus Mauritiana*; its Nutritional and Pharmaceutical Potential

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Abstract

Current studies were performed to overview the phytochemistry, nutritional and medicinal value of *Ziziphus mauritiana* (commonly known as Ber in Pakistan). The leaves of *Z. mauritiana* are comprised of proteins, amino acids, alkaloids, terpenoids, fibers, flavonoids, tannins, glycosides, and phenolic compounds. The leave majorly demonstrate the presence of α-linolenic acid, plamitc acid and methyl stearate in *n*-hexane, chloroform and methanol extracts. The seed contains the highest content of carbohydrate (63.24%) and calorific value (411.61 kJ) while its fruit shows the highest quantity of moisture. Its fruit is slightly acidic (pH around 4.77) and rich in nutrients including proteins, carbohydrates vitamin C and minerals (Fe, Zn, Cu, Na, K, Ca, P).
The fruit provides energy of 1516-1575 kJ per its 100 g. *Z. mauritiana* displays antibacterial, antioxidant and anti-inflammatory activities. Its leaves are used for treating tuberculosis, smallpox, burning sensations, dysentery asthma, fever, liver issues, infections and blood relating diseases. Root bark of this plant shows good effectiveness as analgesic, anti-inflammatory and anti-allergic agent. The plant displays strong antioxidant potential and excellent H$_2$O$_2$ scavenging activities.

**Key words:** *Ziziphus Mauritiana*; Ber; Phytochemicals; Nutritional; Pharmaceutical

1. **Introduction**

Plants have been widely investigated due to their nutritional [1, 2] and pharmaceutical value [3, 4]. The presence of carbohydrates, protein and fat in medicinal plants enables them to fulfill the human body’s requirements; these components also play an important role in numerous morphological, physiological and metabolic activities [5]. It has been reported that consumption of 100 g plant can provide over 10-12% of the daily allowance recommended [6]. Plants are also very important sources of medicines. Many new beneficial medicinal components and their phytochemical constituents (e.g., hypolipidemic, hypoglycemic and antioxidants, constituents) can be isolated from plants. A large number of plant-derived (directly or indirectly) medicines are currently in use [7]. There had been a common interest in the treatment of diseases by plant based medicines from the primitive ages [8]. The use of medicinal plants against diseases by physicians and pharmacologists has been increasing day by day due to increase of the awareness and evolving ideas [7]. Many medicinal plants are being widely used as fruits and vegetables in Pakistan. Such medicinal plants are rich in carbohydrate contents but they are low in fats and proteins [6]. *Ziziphus mauritiana* (commonly known as Ber plant in Pakistan) is a fruit tree that...
has been commonly known due to its medicinal and nutritional benefits [9]. It has 40 species that are distributed in warm temperate and subtropical regions [10]. The flesh of the fruit is white to yellow white, which changes in color with the ripening stages and turns red with skin shrinkage in latest stages (Figure 1) [11]. The fruit of *Z. mauritiana* is varied in shape such as round, oblate to oval and weight of fruit varies from 3.8 g to 39.5 g whereas length of fruit ranges from 1.1 cm to 4.7 cm [12].

Owing to the nutritional and pharmaceutical value of plants [13-15], current studies were made to overview the phytochemistry, antioxidant, nutritional, chemical composition and antimicrobial potential of *Z. mauritiana*.

![Figure 1: Fruits and Leaves of Ziziphus Mauritiana [11]](image)

## 2. Chemical composition

The leaves (Figure 1) of *Z. mauritiana* are chemically comprised of proteins, amino acids, alkaloids, terpenoids, fibers, flavonoids, tannins, glycosides, and phenolic compounds [16]. The GCMS analysis of *n*-hexane, chloroform and methanol extracts of *Z. mauritiana* leaves were investigated. Methanolic extract of leaves have shown the presence of diglycerol (0.30%), 2,3-dihydrobenzofuran (0.60%), 1,2-diacetate glycerol (1.44%), methyl palmitate (7.81%), palmitic acid (13.57%), linoleic acid methyl ester (5.98%), phytol (9.78%), methyl stearate (15.59%),
lioleic acid (4.75%), α-linolenic acid (14.21%), stearic acid (1.94%), archidic acid methyl ester (1.60%), carbromal (0.76%), 3-methyl piperidine (0.48%), cyclobarbital (0.61%), squalene (12.09%), vitamin E (2.35%) and thymol TMS (1.26%). The chloroform extract contained uneicosane (4.79%), lauric acid (1.66%), myristic acid (2.80%), E-15-Heptadecenal (12.31%), methyl palmitate (2.83%), palmitic acid (38.55%), hentriaconate (3.25%), methyl stearate (2.31%), stearic acid (5.82%), α-nonadecylene (3.77%), bacchotricuneatin C (3.48%), α-tocopherol (10.01%) and vitamin E (5.41%). The n-hexane extract of Z. mauritiana leaves have displayed the presence of myristic acid (0.73%), phytol acetate (1.02%), methyl palmitate (1.01%), palmitic acid (16.26%), linoleic acid, methyl ester (0.45%), phytol (2.52%), methyl stearate (0.53%), linoleic acid (1.37%), α-linolenic acid (26.45%), o-methyl delta-tocopherol (0.47%), octacosane (2.04%), squalene (12.83%), trans-geranylgeraniol (2.34%), 2,4-dimethyl Benzoquinoline (2.28%), α-tocopherol (3.92%), 4-chloro-2-trifluoromethylbenzoquinoline (1.74%), γ-sitosterol (2.72%) and 17-Hydroprogesterone (3.42%). Thus α-linolenic acid (26.45%), palmitic acid (38.55%) and methyl stearate (15.59%), were observed as major components in n-hexane, chloroform and methanol extracts, respectively. The chloroform extract possessed the highest amount of phenolics while the flavanoids were present as chief constituents in methanol extract [9]. According to literature, twelve compounds including betulinic aldehyde, palmitoleic acid, ceanothic acid, daucosterol-6'-octadecanoate, spinosin, betasitosterol, daucosterol-6'-octadecanoate, frangufoline, stearic acid, docosanoic acid, sucrose, betulinic acid have been identified from seeds of Z. mauritiana. Silica column chromatography was used for the isolation of these constituents whereas spectroscopic analysis and physico-chemical properties were used for structure elucidation [17]. In addition to above mentioned substances, fruits of Z. mauritiana contain several bioactive phytochemicals such as phenolic
acid ascorbic acid [18]. The presence of saponin, terpenoids, flavanoid, tannins and cyanogenic glycosides has been reported in pulp of *Z. mauritiana* [19, 20].

The highest contents of calorific value (411.61 kJ), carbohydrate (63.24%), fat (1.89%) and crude fiber (48.12%) have been reported in the seed while the moisture content (88.32%) was found to the highest in fruit of *Z. mauritiana*. The pH of the fruit and leaves was found to be 4.77 and 5.47, respectively. The *Z. mauritiana* plant serves an excellent source of fiber, proteins and carbohydrates. It was suggested that its fruit, leaves and seed may find potential applications as nutraceutical ingredients in pharmaceutical and food products [21].

### 3. Nutritional value

The fruit of *Z. mauritiana* is enriched with nutrients. It is suggested that its fruits contain iron more than an apple and it is a well-known fact that iron is so much necessary for the transportation of oxygen in body [22]. Researchers have shown that edible parts of this fruit contain higher amount of nutrients and minerals such as iron, zinc, calcium, sodium magnesium and vitamin C etc. [23, 24]. It is suggested that 100 g of pulp contain 70-165 mg of ascorbic acid (vitamin C) [25]. Its fruits are enriched with vitamin A and B complex [26]. Besides the nutrients, fruits of *Z. mauritiana* provide 20.9 kcal per 100 g pulp [22]. The fruit is an excellent source of proteins, carbohydrates, and micronutrients, such as vitamin C, zinc (Zn), iron (Fe), copper (Cu), phosphorus (P), sodium (Na), potassium (K) and calcium (Ca). In Zimbabwe, the fruits of *Z. mauritiana* contribute significantly to people’s diet when they are in season. The edible portion of ber may be sour and sweet. In 100 grams of ber (sour and sweet), the weight of the dry contents of the edible portion ranges from 21.1 g to 24.1 g. Dry weight of 100 g of edible portion contains crude fiber (4.9 g to 7.3 g), crude proteins (7.9 g to 8.7 g), fat contents (0.8 g to 1.5 g) and carbohydrate content (79.5 g to 83.2). The fruits of *Z. mauritiana* are rich in vitamin C.
and have energy value of 1516-1575 kJ per 100 g. Table 1 shows the concentrations of different nutrients [16, 24].

Table 1: Concentration of different nutrients in 100 grams of fruit of Z. mauritiana [16, 24]

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Conc. in mg /100 g of fruit</th>
<th>Nutrients</th>
<th>Conc. in mg /100 g of fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium (Ca)</td>
<td>160-254</td>
<td>Iron (Fe)</td>
<td>2.1-4.3</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>1865-2441</td>
<td>Zinc (Zn)</td>
<td>0.6-0.9</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>83-150</td>
<td>Copper (Cu)</td>
<td>0.7</td>
</tr>
<tr>
<td>Sodium (Na)</td>
<td>185-223</td>
<td>Manganese (Mn)</td>
<td>1.6</td>
</tr>
<tr>
<td>Phosphorus (P)</td>
<td>87-148</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Pharmaceutical Importance

Plants are sources of many natural drugs and useful for the treatment of chronic diseases [14]. It is estimated that herbal medicines and their formulated drugs contribute more than 60% of clinical drugs in the world [27]. It was reported by WHO that 80 percent of world population is dependent on the drugs derived from plants [28]. Z. mauritiana has has gained much importance for the treatment of many diseases for example; its leaves are used for treating tuberculosis and blood relating diseases. For small pox therapy, juice of leaf along with buffalo’s milk is considered effective. The paste of leaves is used on wounds to get rid of burning sensations. Conventionally, for urinary tract infection treatments, dose of fresh leaves of Z. mauritiana and cumin is given to the patient. To cure dysentery, roots of the plant are used with cow’s milk. Patients are advised by conventional therapists to keep fresh root of Z. mauritiana in their mouth to get rid of hoarseness of throat [29-31]. Almost all parts of plants show potential for treatment of numerous diseases for example roots and stem are traditionally used for the treatment of
dysentery and diarrhea. Root bark of this plant shows good effectiveness as analgesic, anti-inflammatory and anti-allergic agent [32].

*Z. mauritiana* is also very useful in treatment of pregnancy related problems such as nausea, vomiting and abdominal pains. Diseases like asthma, fever and liver issues can also be treated with *Z. mauritiana* leaves [33]. It is experimentally proved that extracts of different parts of *Z. mauritiana* possess high potential against cancer, inflammation and diabetes [34-37].

It can be summarized that *Z. mauritiana* was traditionally used for culinary uses, medicinal purposes, and maintenance of health and for improvement of digestion [38-42]. Antibacterial, antioxidant and anti-inflammatory activities are some medicinal properties of this plant [29, 30].

### 4.1. Antimicrobial activity

It is reported that different antimicrobial activities against different microorganisms are displayed by extracts of *Z. mauritiana* leaves. For the therapy of microbial infections, many antimicrobial components are present in *Z. mauritiana* plant [11, 20, 43-45]. It’s also reported that methanolic extract of *Z. mauritiana* leaves shows the antimicrobial activities against different bacteria and thus shows great antibacterial potential [20].

A wide range of phytochemicals are present in the pulp of *Z. mauritiana*; due to which it (crude and fractionated extracts) also shows antimicrobial potential. Some studies on *Z. mauritiana* reveal the occurrence of secondary metabolites like tannins and terpenoids and flavonoids having antibacterial potential [11, 44, 45]. Various researchers reported that *Z. mauritiana* is used as anti-diabetic neuroprotective and hepatoprotective agent [46, 47].

### 4.2. Antioxidant Potential

One of the many causes of increasing mortality rate in the world is cancer. Cancer is an important cause of mortality throughout the world. Many therapeutic methods are invented
for the treatment of cancer; these methods also include chemotherapy which shows many adverse effects on healthy tissues. Therefore it becomes the need of current era to develop alternate strategies for the treatment of diseases. Plants extracts show many interesting results in this regards [48]. Oxidative stress is the condition in which oxidants are increased in number and disturb the natural cellular reactions of body. If this condition is prolonged then it may result in different diseases (like cancer) [49, 50]. This condition is reversed by antioxidants. Antioxidants are those agents that have the ability to inhibit, delay or interfere in the aerobic reactions by neutralizing free radicals (by donating electron or atom, quenching oxygen in triplet and singlet form and chelating metals). Thus, they also plays an important role in increasing the food shelf life period and in reduction of ailments like cancer, aging and inflammation [51]. There are naturally occurring compounds (phytochemicals) present in plants that possess potential to inhibit numerous diseases due to their antioxidant effects [52].

There are several investigations which report the antioxidant potential of *Z. mauritiana* [53]. The good antioxidant and H₂O₂ scavenging activities can be owed to the presence of high amount of total proteins, reducing sugars, flavonoids, ascorbic acid contents, β-carotene, polyphenols, tannins and DPPH free radicals [54, 55]. It was reported by different researchers that there are about eight different flavonoids in fruits, leaves and seed of *Z. mauritiana* [56]. It has also been reported that phenolic acids are present in this plant in free/conjugated from, along with carbohydrates and other biomolecules [57].

The crude methanolic extract of *Z. mauritiana* leaves is rich in phytochemical constituents which have significant antioxidant and antimicrobial activities. The isolation and purification of these bioactive phytochemical constituents may further produce more potent antioxidants [55]. It is
reported that methanolic seed extracts of this plants are markedly effective against the cancerous cells. Also ethanolic extracts of seed have shown ability of inhibiting the proliferation of HL60 cells [58].

5. Conclusions

Z. mauritiana is a very important medicinal plant whose different plant parts can be utilized for curing numerous diseases including tuberculosis, small pox, burning sensations, dysentary asthma, fever, liver issues, infections and blood relating diseases. Root bark of this plant shows good effectiveness as analgesic, anti-inflammatory and anti-allergic agent. The plant displays strong antioxidant potential and excellent \( \text{H}_2\text{O}_2 \) scavenging activities. The fruit of Z. mauritiana is slightly acidic (pH around 4.77) and rich in nutrients including proteins, carbohydrates vitamin C and minerals (Fe, Zn, Cu, Na, K, Ca, P). The fruit provides energy of 1516-1575 kJ per its 100 g. Phytochemical studies have shown the presence of proteins, amino acids, alkaloids, terpenoids, fibers, flavonoids, tannins, glycosides, and phenolic compounds in leaves of Z. mauritiana. The seed contains the highest content of carbohydrate (63.24%) and calorific value (411.61 kJ) while its fruit shows the highest quantity of moisture.

Conflict of Interest

Authors declare no conflict of interest.

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