

Full Length Research Paper

Ethnobotanical and taxonomic screening of genus *Morus* for wild edible fruits used by the inhabitants of Lesser Himalayas-Pakistan

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The present study was focused on ethnobotanical and taxonomic screening of four wild edible fruit species of family Moraceae including *Morus alba* L., *Morus laevigata* Wall., *Morus nigra* L. and *Morus rubra* L. used by the local inhabitants of Lesser Himalayas-Pakistan. Questionnaires based on semi-structured interviews and observations were used to collect data about ethnobotanical importance of these plants. Morphological, including organoleptographical characters of leaves, flowers, fruits and leaf epidermal anatomy were investigated. Leaf epidermal anatomy was carried out under light microscope. All four species showed variations in fruit size, shape, color, in leaf lamina and base shape, floral characters, leaf epidermis cells shape, size and type of stomata. Such taxonomic variations are significant in correct identification of plant species.

Key words: Ethnobotanical, taxonomic screening, *Morus*, Lesser Himalayas.

INTRODUCTION

The Pakistani Himalaya is located south and east of the Indus River, which originates close to the holy mountain of Kailash in Western Tibet, marking the ranges true western frontier. The Himalaya is a totally separate range to the Karakoram which runs parallel to the north. The Himalaya in Pakistan is green and fertile as compared to the arid Karakoram and Hindukush. The Himalaya is spread across three Pakistan's provinces. The Northern area encompasses the Nanga Parbat massif and her

surrounding valleys, Azad Jammu and Kashmir and extreme South-east corner of the North West Frontier Province (Pakhtoonkhawa). The Lesser Himalaya is a prominent range 2,000 to 3,000 m high formed along the main boundary Thrust fault zone, with a steep southern face and gentler northern slopes. These Himalayas lie north of the Sub-Himalayan Range and south of the Great Himalayas. In Pakistan these mountains lie just North of Rawalpindi district, covering the districts of

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Batagram, Mansehra and Abbottabad as well as Pakistan Administered Kashmir. These mountains are also home to Pakistan's important hill stations like Murree, Ghora Gali and Nathia Gali. It snows here during a few months of the year but there are no glaciers found in this region. The climate of the Lesser Himalayas ranges from tropical at the base of the mountains to permanent ice and snow at the highest elevations. The amount of yearly rainfall increases from west to east along the front of the range. This diversity of climate, altitude, rainfall and soil conditions generates a variety of distinct plant and animal communities (Anonymous, 2010).

Traditional fruits represent inexpensive but high quality nutrition sources for the poor segment of the population, especially where malnutrition is widespread. Traditional fruits grow wild and are readily available as they do not require any formal cultivation. Wild edible plants (fruits and vegetables) are necessary for the well being of the populations, not only as source of supplemental food, nutritionally balanced diets, medicine, fodder and fuel, but also for developed methods of resource management, which may be fundamental to the conservation of some of the world's important habitats (Chweya and Eyzaguirre, 1999).

Morphology plays a basic role in the field of Taxonomy. The taxonomic keys and identification are mostly the result of morphological studies. Leaf epidermal tissue characteristics have an important role in taxonomy of plant genera and species (Scatena et al., 2005; Strgulc et al., 2006; Uphof, 1962; Yang and Lin, 2005). The epidermis possesses a number of important diagnostic characters that offer valuable clues for identification, like size, shape and orientation of stomata, guard cells and subsidiary cells, structural peculiarities of epidermal cell walls, distinctive or specialized form of trichomes (Dickson, 2000). The aim of present investigation was to study ethnobotanical and taxonomic features of four wild edible fruits species of genus *Morus*. No such reference exists on the comparative organoleptographic and taxonomic description with reference to this genus.

METHODOLOGY

Questionnaires and observations were made to record ethnobotanical data about plant species. Fresh samples of about 5 to 6 specimens of each plant were collected from different areas of Lesser Himalayas. Voucher specimens were deposited in Herbarium of Pakistan, Quaid-i-Azam, University, Islamabad after correct identification. Using the modified methodology of Shaheen et al. (2009), fresh leaves were infused in 30% nitric acid with 2.0 g of potassium chloride in a test tube for 2 to 3 min. These leaf pieces were then washed with distilled water twice. Epidermis was peeled off and kept in 60% potassium hydroxide solution for 1 to 2 h. Finally, thin sections of epidermis were suspended in lactic acid on glass slide for light microscopic (LM) study. Microphotographs were taken by using CCD digital camera (Model: DK 5000) fitted on Leica

light microscope (Model: DM 1000).

RESULTS

Morus alba L.

Local name: Chitta toot; English name: White mulberry. Distribution: Pakistan, Hazara, Swat, Kashmir and Murree. World: Native to China, Asia, Japan, Malaya, Burma, India, North Africa. Habitat: It grows commonly on the clay soil. Flowering period: February to March. Fruiting period: May to June. Morphology:

A monoecious, deciduous, 8 to 15 m or rarely up to 20 m tall tree with a dense, compact leafy crown. Trunk is 1.5 to 2 m in circumference, with dark grey-brown, rough, vertically fissured bark, tender twigs airy to glabrescent. Leaves are green, sticky, herbaceous, 12.1 to 2.9 cm long and 12.5 to 1.6 cm wide, ovate, alternate, somewhat hairy, scabrous, insertion of leaf; ramal, petiolate, lamina narrow to broad, shallowly cordate base, upper surface glabrous, midrib and veins pubescent, margin; regularly serrate, Apex; obtuse, acute or shortly acuminate, stipule; brownish, lanceolate and hairy. Male catkins is 10 to 20 mm long including slender, hairy peduncle, 5.6 mm broad, with flowers. Male flowers: sepals free, broadly ovate, 2.5 mm long, cucullate, obtuse, glabrous to hairy; staminal filaments equal to sepals, with ovate, exserted anthers. Female catkins is ovoid, 5 to 10 mm long, without equally long or slightly longer peduncle. Female flowers: sepals sub orbicular, as long as or slightly larger than male flowers, glabrous or ciliate on margins; ovary with glabrous free styles (Plate # 1).

Organoleptography of fruits: Dark green (unripe), pale yellow to creamy (ripe), edible, sweet, axillary, simple succulent, fleshy, sorosis, drupelets, oval, up to 2.24 cm long, 2.18 cm wide and 3.29 cm circumference. Exocarp, mesocarp and endocarp are indistinct (Plate # 2).

Leaf epidermal anatomy: Costal and inter costal zonation conspicuous. Epidermal cells on the abaxial and adaxial surfaces are variously shaped. The size of epidermal cells; adaxial 33.41 (27.5 to 37.75) × 18.58 (13.25 to 22.5) µm, abaxial 20.83 (12.5 to 27.5) × 10.08 (7.5 to 12.75) µm. Stomata are absent on adaxial surface while on abaxial surface anomocytic to desmocytic stomata are present. Size of stomatal complex is 17.5 (12.5 to 22.5) × 9.58 (6.25 to 12.5) µm while size of aperture is 9.08 (7.5 to 10) × 2 (0.25 to 3) µm. Peltate glands and hooked hairs were also present on adaxial surface. Non-glandular and unicellular trichomes are present on the adaxial surface. The size of trichome is 165 (20 to 250) µm while the base of trichome is rounded



Figure 1. Leaf epidermal anatomy of *Morus alba* L.



Figure 2. Leaf epidermal anatomy of *Morus nigra* L.

having breadth of 22.66 (12.5 to 25.5) μm , while glandular and unicellular trichomes are present on abaxial surface. The size of trichome is 43.33 (37.5 to 47.5) $\times$ 7.58 (7.5 to 7.75) μm (Figure 1).

Ethnobotanical uses: Fruits are cool and laxative used to cure sore throat, dyspepsia and melancholia. Wood is used as fuel, in tool handles and construction. Fresh leaves are used as fodder for goats and sheep.

***Morus nigra* L.**

English name: Black mulberry. Local name: Kala Toot. Distribution, Pakistan: cultivated and grows wild through out the country. World: Westwards to Asia Minor, Central and South Europe, North Africa, Central Asia and U.S.A. Habitat: It grows commonly on the clay soil. Flowering period: February to March. Fruiting period: March to April.

Morphology: A monoecious, dioecious, medium or small sized tree, up to 10 m tall, with a compact spreading wide crown. Trunk is 1 to 2 m in circumference with fissured rough bark, tender twigs which are reddish-brown, with densely hairy. Leaves that are green, glaucous, scabrous above, herbaceous, 11.7 to 4.5 cm long and 8.1 to 4.2 cm wide, insertion of leaf is ramal, petiolate, lamina broad ovate, deeply cordate base, somewhat hairy. Margin: crenate-dentate, Apex: acuminate to caudate, stipules; pale brown, lanceolate, hairy. Male catkins is 25 to 35 mm long, including dense hair, up to 10 mm long peduncle. Flowers: sepals free, broadly ovate, 2.5 to 3 mm long, 23 mm wide, deeply concave, lanate-hairy outside; stamens with broadly oval, exerted anther. Female catkins are oval, 15 to 28 mm long including 6 to 8 mm long, hairy peduncles. Female flowers: sepals broadly elliptic, 3 to 3.5 mm long, 2.5 to 3 mm broad, hairy outside; ovary with densely white hair and divergent styles (Plate 3).

Organoleptography of fruits: Dark green (unripe), black (ripe), edible, sweet, axillary, simple succulent, fleshy, berry, globular, up to 2.59 cm long, 2.29 cm wide and 3.57 cm circumference. Exocarp, mesocarp and endocarp are indistinct (Plate 4).

Leaf epidermal anatomy: Costal and intercostals zonation conspicuous. Epidermal cells on abaxial and adaxial surfaces are variously shaped. The size of epidermal cells; adaxial 25 (22.5 to 27.5) $\times$ 16.75 (12.75 to 20) μm , abaxial 21.75 (17.5 to 25.25) $\times$ 11.58 (10 to 12.5) μm . Peltate glands and hooked hair are also present on adaxial surface. Stomata are absent on adaxial surface while on abaxial surface anomocytic stomata are present. Size of stomatal complex is 18.41 (12.75 to 22.5) $\times$ 6 (5.25 to 7.5) μm while size of aperture is 10.16 (7.5 to 13) $\times$ 1.91 (0.25 to 2.75) μm . Glandular and unicellular trichomes having pointed heads are present on the adaxial surface. The size of trichome is 40.91 (40 to 42.5) μm while the base of trichome is rounded having breadth of 9.16 (7.5 to 12.5) μm , while unicellular glandular as well as non-glandular trichomes and hooked hairs are present on abaxial surface. The size of glandular trichome is 17.58 (12.25 to 27.5) and its base is rounded having breadth of 10.75 (7.5 to 12.5) μm . The size of non-glandular trichome on abaxial surface is 216.66 (87.5 to 250) μm , the base of trichome is also rounded having breadth of 52.5 (50 to 55) μm (Figure 2).

Ethnobotanical uses: The leaves are used for feeding silkworms. Leaves infusion is used to control sugar level and blood pressure. Fruits are edible and considered as refrigerant and laxative. Leaves are also used as fodder. Wood is used as fuel and in construction. Young soft and flexible branches are used in making baskets.



Figure 3. Leaf epidermal anatomy of *Morus laevigata*.

***Morus laevigata* Wall.**

Local name: Shah Toot. English name: Long black mulberry. Distribution, Pakistan: Haripur, Abbottabad, Swat, Hazara, Peshwar, Rawalpindi. World: India, Nepal, West and South China and Indo-China. Habitat: It grows rarely on the clay soil. Flowering period: March to April. Fruiting period: May to June. Morphology: A small to large tree, up to 10 m tall with a dense crown. Trunk is 1.5 to 2 m in circumference, with grey smooth bark, young shoots long soft and hairy. Leaves: Dark green, herbaceous, 12.8 to 4.8 cm long and 8.9 to 3.4 cm wide, pubescent petiole, up to 2.5 to 4 cm long, lamina glaucous, ovate to rotundate, cordate base, sparsely pubescent to glabrous. Insertion of leaf: ramal. Margins: serrate, shortly acuminate, Apex: obtuse to acute, stipules: brownish, lanceolate and hairy. Male catkins are 5 to 10 cm long including a slender 1.5 cm long, pubescent peduncle, densely hairy. Male flowers: Sepals 4, ciliate on margins; staminal filaments as long as sepals. Female catkins are cylindrical, 5 to 12 cm long including 2 cm long peduncle, pendulous, lax-flowered and almost glabrous. Female flowers: sepals 4, imbricate, thin, with outer 2 concave-rotundate, inner ones are plane, floccose-ciliate on margins; ovary with elongated, bipartite style, with stigmas that are patent (Plate 5).

Organoleptography of fruits: Dark green (unripe), yellowish white (ripe), axillary, edible and somewhat sweet, multiple fruits and sorosis, flattened, up to 4.3 cm long, 1.2 cm wide and 2.2 cm circumference. Exocarp, mesocarp and endocarp are indistinct (Plate 6).

Leaf epidermal anatomy: Costal and intercostals zonation are conspicuous. Epidermal cells on the abaxial surface are undulating to irregular shaped while on the adaxial surfaces the cells are variously shaped. The size

of epidermal cells; adaxial $36.66 (30 \text{ to } 42.5) \times 21.66 (17.5 \text{ to } 25) \mu\text{m}$, abaxial $41.25 (23.75 \text{ to } 62.5) \times 13.41 (10 \text{ to } 17.5) \mu\text{m}$. Peltate glands and hooked hairs are also present on adaxial surface. The stomata are absent on the adaxial surface while anomocytic to anomotetracytic stomata are present on the abaxial surface. Size of stomatal complex is $20.75 (17.5 \text{ to } 24.75) \times 14.25 (10 \text{ to } 17.5) \mu\text{m}$ while size of aperture is $12.5 (10 \text{ to } 15) \times 2.93 (2.75 \text{ to } 3.25) \mu\text{m}$. Glandular and unicellular trichomes are present on adaxial surface. The size of trichome is $45 (43.5 \text{ to } 46.25) \mu\text{m}$, while base of trichome is rounded having breadth of $3.125 (3 \text{ to } 3.25) \mu\text{m}$. On abaxial surface trichomes and glands are absent (Figure 3).

Ethnobotanical uses: Ripe fruits are edible, laxative and refrigerant. Leaves are excellent fodder for goats and sheep. Wood is used in making tool handles and in decoration pieces.

***Morus rubra* L.**

English name: Black mulberry. Local name: Shah Toot Kala. Distribution, Pakistan: Swat, Hazara, northern areas, Murree, Ghora gali. World: Southern New Mexico and Eastern North America. Habitat: It grows rarely on the clay soil. Flowering period: February to March. Fruiting period: April to June. Morphology: A tree up to 12 m tall. Bark is gray-brown with orange tint, furrows shallow, ridges flat, broad. Branchlets are red-brown to light greenish brown, glabrous or with a few trichomes; lenticels are light colored, elliptic, prominent. Buds are ovoid, slightly compressed, 3 to 7 mm, apex acute; outer scales are dark brown, often pubescent and minutely ciliate; leaf scars are oval to irregularly circular, bundle scars are numerous, in circle. Leaves: green, herbaceous, 5.8 to 8.1 cm long and 3.6 to 5.2 cm wide, glaucous, oblong-ovate, insertion of leaf: ramal, petiole up to 2 to 3.3 cm long. Margin: serrate to dentate, Apex: abruptly acuminate, leaf base: broadly ovate. Catkins: peduncle pubescent; staminate catkins 3 to 5 cm; pistillate catkins 8 to 12 $\times$ 5 to 7 mm. Flowers: staminate and pistillate on different plants. Staminate flowers: sepals connate at base, green tinged with red, 2 to 2.5 mm, pubescent outside, ciliate toward tip; stamens 4; filaments 3 to 3.5 mm. Pistillate flowers: calyx tightly surrounding ovary; ovary green, broadly ellipsoid or obovoid, slightly compressed, 1.5 to 2 mm, glabrous; style branches divergent, whitish, sessile, 1.5 mm; stigma papillose (Plate 7).

Organoleptography of fruits: Dark green (unripe), red or black (ripe), axillary, edible, sweet, multiple fruit and sorosis, flattened, up to 6 cm long, 1.6 cm wide and 2.6 cm circumference. Exocarp, mesocarp and endocarp are



Figure 4. Leaf epidermal anatomy of *Morus rubra*.

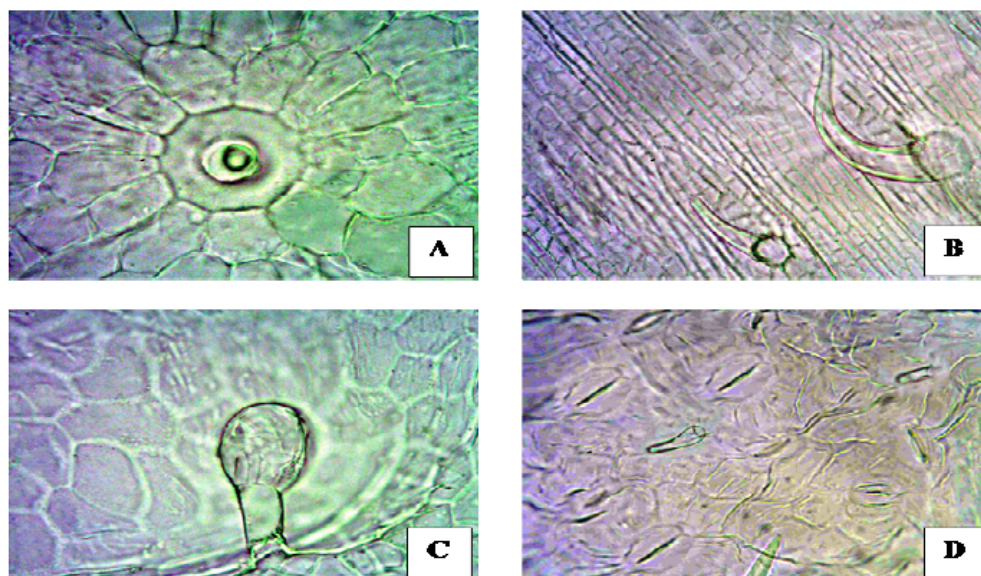


Plate 1. *Morus alba*. A: Peltate glands on adaxial surface (40×), B: Hooked hairs and unicellular trichomes on adaxial surface (20×), C: Glandular trichomes on abaxial surface (40×). D: Stomata and glandular trichomes on abaxial surface (20×).

indistinct (Plate 8).

Leaf epidermal anatomy: Zonal and interzonal cells are conspicuous. Epidermal cells on abaxial and adaxial surfaces are variously shaped. The size of epidermal cells; adaxial $33.33 (30 \text{ to } 37.5) \times 21.75 (20.25 \text{ to } 22.5) \mu\text{m}$, abaxial $30 (27.5 \text{ to } 32.5) \times 14.25 (12.5 \text{ to } 15.25) \mu\text{m}$. Peltate glands and hooked hairs are also present on adaxial surface. The stomata are absent on the adaxial surface while actinocytic and anomocytic stomata are present on the abaxial surface. Size of stomatal complex is $19.88 (19.75 \text{ to } 20) \times 18.16 (17 \text{ to } 20) \mu\text{m}$ while size of

aperture is $12.33 (12 \text{ to } 12.5) \times 4.91 (4.75 \text{ to } 5) \mu\text{m}$. Unicellular glandular as well as non-glandular trichomes are present on both surfaces. The size of unicellular glandular trichome: Adaxial, $127.91 (112.5 \text{ to } 157.5) \times 26.58 (24.75 \text{ to } 30) \mu\text{m}$, abaxial, $29.91 (27.5 \text{ to } 32.25) \times 13.66 (12.25 \text{ to } 16.25) \mu\text{m}$, while the size of unicellular non-glandular trichomes is: Adaxial, $27.83 (27.25 \text{ to } 29.75) \times 15 (14.75 \text{ to } 15) \mu\text{m}$, Abaxial, $38.25 (27.25 \text{ to } 29.75) \times 14.16 (10 \text{ to } 20) \mu\text{m}$. The base of trichome is rounded and stomata on abaxial surface (20×), D: Non-glandular and Glandular trichomes and stomata on abaxial surface (20×) (Figure 4).

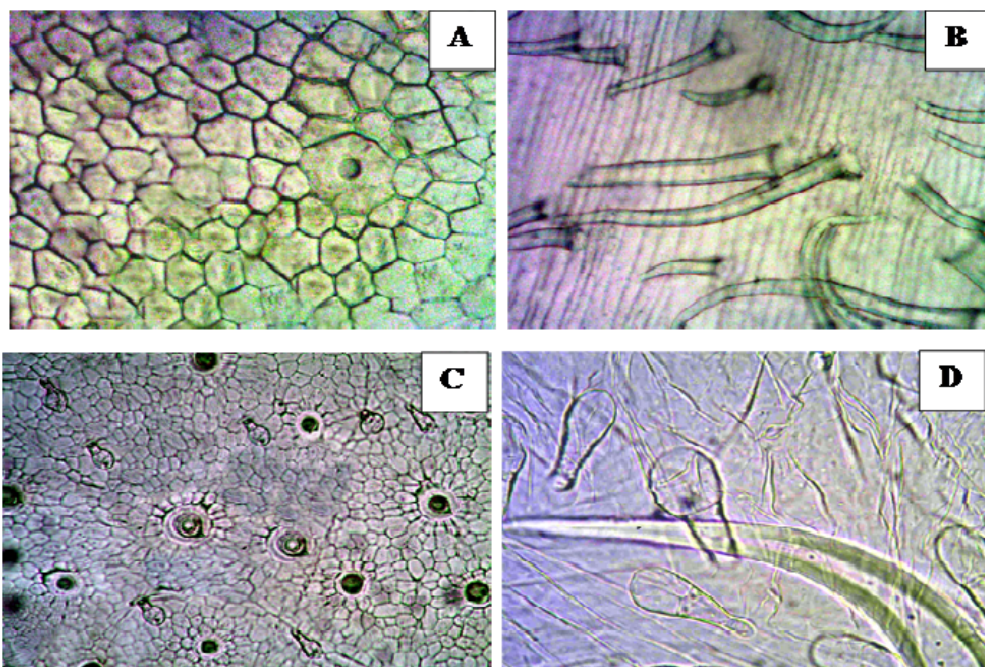


Plate 2. *Morus nigra*. A: Peltate glands on adaxial surface (20×), B: Non-glandular trichomes, hooked hairs on adaxial surface (10×), C: Glandular and unicellular trichomes on abaxial surface (10×), D: Glandular trichomes and hooked hair on abaxial surface (20×).

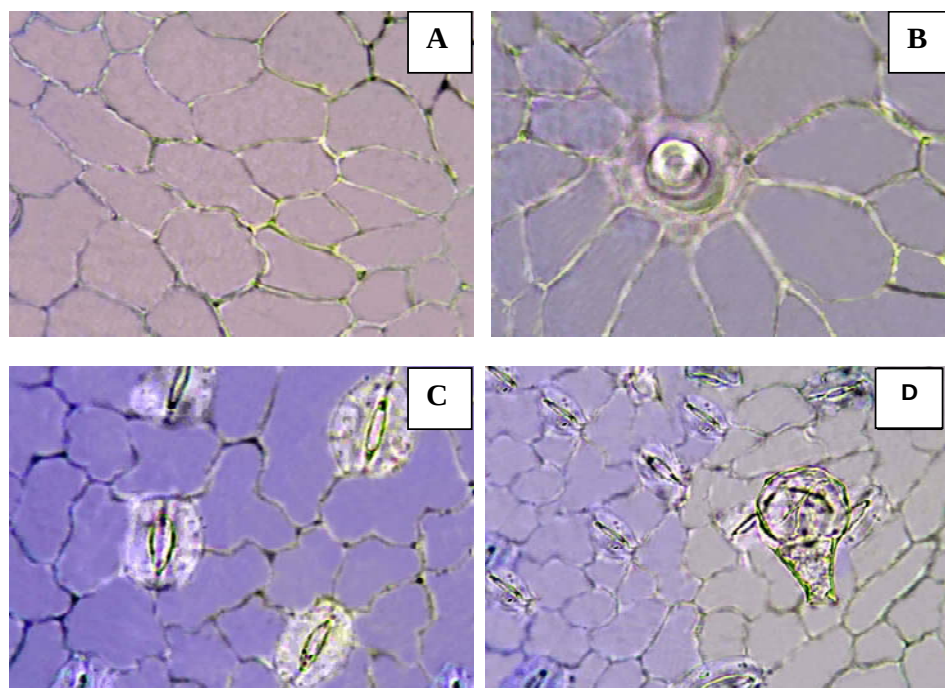


Plate 3. *Morus laevigata*. A: ordinary epidermal cells adaxial surface (40×), B: Peltate glands on adaxial surface, C: Stomata on abaxial surface (40×), D: Glandular trichomes and stomata on abaxial surface (20×).

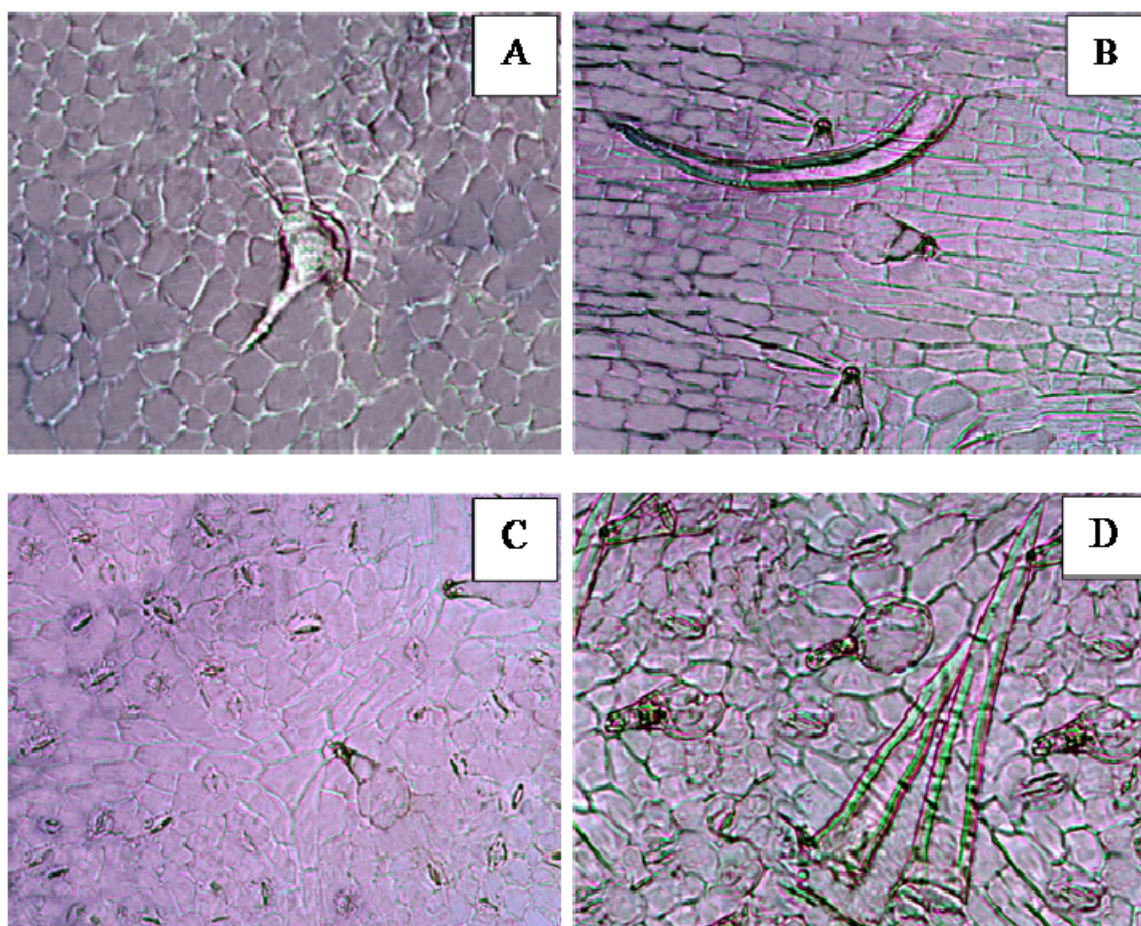


Plate 4. *Morus rubra*. A: Peltate glands and hooked hairs on adaxial surface (20x), B: Hook. Ethnobotanical uses: Fruits are laxative and purgative. Root infusion is useful in weakness and urinary problems. Tree sap rubbed directly on the skin as treatment for ringworm. Also used as fodder and in construction.



Plate 5. Organoleptography of fruits of *Morus alba* L.



Plate 6. Organoleptography of fruits of *Morus laevigata*.



Plate 7. Organoleptography of fruits of *Morus nigra* L.



Plate 8. Organoleptography of fruits of *Morus rubra*.

Ethnobotanical uses: Ripe fruits are edible, laxative and refrigerant. Leaves are excellent fodder for goats and sheep.

DISCUSSION

Pakistan is one of the developing countries having great potential of wild flora especially with reference to edible fruit bearing plants. Due to varied edaphic and climatic conditions, about 6000 flowering plant species have been reported from Pakistan. Majority of these plant species have ethnobotanical importance. During present work, preference was given to four edible species of genus *Morus* grown widely through out lesser Himalayas. These plants species not only are sources of edible fruits but

they are also used as medicinal plants, fuel wood, fodder, in construction, furniture, tool handles etc. Because of more ethnobotanical importance, these species are under high anthropogenic pressure, which demands their urgent conservation.

The comparative study of plant structure as morphology and anatomy has always been the backbone of the plant systematic, which endeavors to elucidate plant diversity, morphology and evolution. During the present investigation, four species of family Moraceae as *Morus alba*, *M. nigra*, *M. laevigata* and *M. rubra* were examined taxonomically which showed diversity in their morphological and anatomical features. Although these four species show some similarities in their characters like catkin inflorescence and sorosis type of fruits, there are remarkable differences in their shape of lamina; as ovate (*M. alba*), broadly ovate (*M. nigra*), ovate to rotundate (*M. laevigata*) and oblong-ovate (*M. rubra*). Lamina base; cordate (*M. alba* and *M. laevigata*), deeply cordate (*M. nigra*) and broadly ovate in *M. rubra*. Similarly, there is great diversity in leaf margin, apex and inflorescence of these species.

Organoleptographic characters indicates that fruit color in four species is different as pale yellow (*M. alba*), Black (*M. nigra*), yellow to white (*M. laevigata*) and reddish to black (*M. rubra*). Fruits length also varies as long fruits (4.3 to 6.5 cm) are present in *M. laevigata* and *M. rubra* while small but wide fruits are found in *M. alba* and *M. nigra*.

The leaf epidermal anatomy is one the most significant taxonomic characters studied in number of families based on leaf epidermis anatomy (Bhatia, 1984; Jones, 1986). According to Scotland et al. (2003), rigorous critical anatomical studies of morphological features in the content of molecular phylogenies are fruitful to integrate the strength of morphological data. Leaf epidermis anatomy also shows variation in anatomical features of these species (Table 1). Although there were similarities in epidermal cells in all four species of *Morus* but variation in shapes of epidermis cells can be observed (Figures 1 to 4). Variations can also be observed in the length and width measurement of these epidermis cells (Table 2). Hooked hairs and trichomes have been recorded on both adaxial and abaxial surface of these species except *M. nigra* where unicellular trichomes with pointed ends can be observed (Figure 3). There is also variation in the type and presence of stomata. Mostly, different types of stomata like anomocytic-desmocytic (*M. alba*); anomocytic (*M. nigra*); anomocytic-anomotetracytic (*M. laevigata*) and cyclocytic- anomocytic (*M. rubra*) were observed on abaxial surface (Figures 1 to 4). Presence of different stomata on same leaf indicates the systematic value of this character but its potential value, if properly interpreted and used with other characters, is substantial (Raju and Rao, 1977; Isawumi, 1989).

Table 1. Qualitative analysis of foliar epidermal cells characteristics.

Plant species	Leaf epidermis (Ad/Ab)			Stomata		Trichomes		Glands
	Shape		Margin/wall morphology	P/A	Type	P/A	Type (Glandular/ Non glandular)	
	Ad	Ab		(Ab/Ad)		(Ab/Ad)		
<i>Morus alba</i>	Variously shaped	Variously shaped	Straight	Ab	Anomocytic to DSesmocytic	P on both	Both	Peltate glands
<i>Morus nigra</i>	Variously shaped	Variously shaped	Straight	Ab	Anomocytic	P on both	Both	Peltate glands
<i>Morus leavigata</i>	Variously shaped	Variously shaped	Straight	Ab	Anomotetracytic and Anomocytic	P on Ad	Glandular	Peltate glands
<i>Morus rubra</i>	Undulating to irregular	Variously shaped	Straight on ab and wavy on ad	Ab	Actinocytic and Anomocytic	Both	Both	Peltate glands

Ad: Adaxial; Ab: Abaxial; P: present; A: Absent.

Table 2. Quantitative analysis of Foliar Epidermal cells characteristics.

Plant species	Surface	Leaf epidermis (µm)	Stomatal complex (µm)	Trichomes (µm)
	Ab/Ad	Length × Width	Length × Width	Length × width
<i>Morus alba</i>	Ab	20.83(12.5 - 27.5)×10.08 (7.5 - 12.75)	17.5 (12.5 - 22.5)×9.58 (6.25 - 12.5)	43.33(37.5 - 47.5)×7.58(7.5 - 7.75)
	Ad	33.41 (27.5 - 37.75)×18.58 (13.25 - 22.5)	Absent	165 (20 - 250)×22.66 (12.5 - 25.5)
<i>Morus nigra</i>	Ab	21.75 (17.5 - 25.25)×11.58 (10 -12.5)	18.41 (12.75 - 22.5)×6 (5.25 - 7.5)	17.58 (12.25 - 27.5)×10.75 (7.5 - 12.5)
	Ad	25 (22.5 - 27.5)×16.75 (12.75 - 20)	Absent	40.91(40 - 42.5)×9.16 (7.5 - 12.5)
<i>Morus leavigata</i>	Ab	41.25 (23.75 - 62.5)×13.41 (10 -17.5)	20.75 (17.5 - 24.75)×14.25 (10 - 17.5)	Absent
	Ad	36.66 (30 - 42.5)×21.66 (17.5 - 25)	Absent	45 (43.5 - 46.25)×3.125 (3 - 3.25)
<i>Morus rubra</i>	Ab	30 (27.5 - 32.5)×14.25 (12.5 - 15.25)	19.88 (19.75 - 20)×18.16 (17- 20)	29.91(27.5 - 32.25)×13.66 (12.25 - 16.25)
	Ad	33.33 (30 - 37.5)×21.75 (20.25 - 22.5)	Absent	127.91 (112.5 - 157.5)×26.58 (24.75 - 30)

Ad: Adaxial; Ab: Abaxial.

Conclusion

The present study was focused on ethnobotanical and taxonomic screening of four species of genus *Morus*. Fruit's organoleptography and leaf epidermal anatomy was studied first time with reference

to Pakistan. Variations were observed in morphological and anatomical features of these species. All the taxonomic characters like leaves shape, size, width, types and size of branches, type of stem, floral characters, fruits morphology, leaf epidermis cells and stomata are important tools which

tools which play key role in the identification of plant species. Genetic diversity and DNA sequencing may also be helpful in this regard. Ethnobotanical investigation revealed that these plant species not only yield valuable edible and medicinal fruits but also an important source of

fuel, fodder and construction. There is an urgent need for conservation of this nature gift.

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REFERENCES

- Anonymous (2010). Wikipedia free encyclopedia. The lesser Himalayan range.
- Bhatia RC (1984). Foliar epidermal studies of *Heliotropium supinum* L. Folia Geobot. Phytotaxon. 19:381-385.
- Chweya JA, Eyzaguirre PB (1999). The Biodiversity of Traditiona Leafy Vegetables. IPGRI Publication.
- Dickison WC (2000). Integrative plant anatomy. Academic Press, San Diego.
- Isawumi MA (1989). Leaf epidermal studies in the genus *Vernonia* schreber tribe Vernoniaceae (compositae) in West Africa. Feddes Repertorium. 100:335-355.
- Jones JH (1986). Evolution of the Fagaceae: The implication of foliar features. Ann. Missouri Bot. Garden 73:228-275.
- Raju VS, Rao PN (1977). Variation in the structure and development of foliar stomata in the Euphorbiaceae. Bot. J. Lin. Soc. 75:69-97.
- Scatena VL, Giulietti AM, Borba EL, van der Berg C (2005). Anatomy of Brazilian Eriocaulaceae: correlation with taxonomy and habitat using multivariate analysis. Plant Syst. Evol. 253:1-22.
- Scotland RW, Olmstead RG, Bennett JR (2003). Phylogeny Reconstruction: the Role of Morphology. Syst. Biol. 52:539-548.
- Strgulc KS, Dermastia M, Jogan N (2006). Determination key for Central European *Epilobium* species based on trichome morphology. Bot. Helv. 116:169-178.
- Uphof JC (1962). Plant Hairs. Encyclopedia of plant Anatomy IV. Borntraeger, Berlin.
- Yang ZR, Lin Q (2005). Comperative morphology of the leaf epidermis in *Schisandra* (schisandraceae). Bot. J. Linn. Soc. 148:39-56.