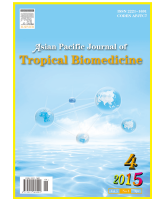




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Ethnobotanical profiling and floristic diversity of Bana Valley, Kotli (Azad Jammu and Kashmir), Pakistan

Muhammad Shoaib Amjad^{1,2*}

¹Department of Botany, Women University of Azad Jammu and Kashmir Bagh, Pakistan

²Department of Botany, PMAS-University of Arid Agriculture Rawalpindi Pakistan

PEER REVIEW

Peer reviewer

Luís Rodrigues da Silva, PhD, REQUIMTE, Faculty of Pharmacy, Porto University, Rua Jorge Viterbo Ferreira 228 4050-313 Porto, Portugal.

E-mail: luisfarmacognosia@gmail.com

Comments

This is a valuable research work about ethnobotanical uses of plants in Bana Valley. Author provides significant information on medicinal plants use among the native people of this region.

Details on Page 298

ABSTRACT

Objective: To document the medicinal and other folk uses of native plants of the Bana Valley of district of Kotli-Azad Jammu Kashmir with a view to preserve the ethnobotanical knowledge of this area and to develop an ethnobotanical inventory of the species diversity.

Methods: The fieldwork was conducted during a period of one year. Data were collected through semi-structured questionnaire and interview of the informants including indigenous people, tribal people, and traditional health practitioners residing in the study area.

Results: The present study documented ethnobotanical uses of 86 plant species belonging to 81 genera and 47 families. This study revealed that most of the species were used medicinally (74 spp; 42.29%). Leaves found to be the most frequently used part (56 spp., 36.13%) for preparation of indigenous recipes and fodder purpose.

Conclusions: The current research provides a huge lump of ethnobotanical knowledge and depicts strong human-plant interaction. It is an urgent need to document indigenous uses of plants for future domestication.

KEYWORDS

Ethnobotany, Bana Valley, Indigenous knowledge, Conservation

1. Introduction

The ethnobotany is the study that investigates complex relationship between plant and human culture[1]. It plays an important role in understanding the dynamic relationships between biological diversity and social and cultural systems[2,3]. The plants have been used for food and medicine since the beginning of human civilization, so the history of ethnobotany is as old as human civilization. The term ethnobotany was first coined by

John Harshberger in 1896[4]. Ethnobotany is perhaps the most important method to study natural resources and their management by indigenous people. It enables us to work with local people to explore knowledge based on experiences of ages. Unfortunately, there is no provision and/or law for the protection of knowledge rights of native people. Very little action has been taken by legal professional environmental, non-governmental or even human rights groups to secure intellectual property rights for native people[5]. The investigation of the cultural values of plant species

*Corresponding author: Muhammad Shoaib Amjad, Department of Botany, Women University of Azad Jammu and Kashmir Bagh, Pakistan.
Tel: 00923453812987
E-mail: Malikshoaib1165@yahoo.com

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plays a significant role in modern medicine, farming, pharmaceutical and nutraceutical industrial sectors of a society[6]. Out of 16%-17% plants present on earth, only 5% have been described and 70% of which are present in tropical and subtropical part of forest. Plants have great potential to cure diseases[7]. Ethnobotanical approaches are significant in highlighting locally important plant species, particularly for new crude drugs. Documentation of indigenous knowledge, in particular the medicinal values of plant species, provides various vital modern drugs[6]. About 25% of drugs originate from plants and many other drugs are synthetic analogues of compounds isolated from plants. About 80% of the people of developing countries are still dependent on traditional indigenous medicines for their basic healthcare[3,8-11].

Pakistan is rich in plant diversity that contains 6000 species of flowering plant, out of which 372 species are endemic. Out of 6000 wild plant species 400-600 species have been commercially exploited[12]. It has been estimated that about 200 plant species are used medicinally by indigenous communities; however, their commercial exploitation is limited. Such species play vital role in our life by containing array of biochemical activities[13]. Ethnobotanical information on curative plants and their uses by indigenous people is valuable not merely in the protection of conventional cultures and biodiversity, but also for community health care and drug development[14].

The ethnobotany of different part of the world and Pakistan has been reported by different researchers[15-26]. With reference to ethnobotany of Azad Jammu and Kashmir, some studies are reported from different parts[10,11,27-30]. Various studies significantly contributed ethnobotanical enumerations from nearby areas. Pie and Manandhara reported that in Himalayan ranges at least 70% of the medicinal plants and animals consist of wild species and 70%-80% of the population in this region depend on traditional medicines for health care[31]. A study worked on the ethnobotany of the Nikyal Valley and reported 111 important species of plants including tree, shrubs and herb species used ethnobotanically by the local people[30]. People living in mountains of Pakistan use plants in many ways such as medicines, timber wood, fire wood, food, fodder etc[32]. The medicinal plants of Himalayas are specific and their distribution is scattered and restricted to small areas[33]. However, there are many parts of the country that remain unexplored with reference to ethnobotanical point of view. Since most population of the area is rural population with low literacy rate and lack of modern health facilities, they are more dependent upon natural resources especially plants for their healthcare and daily life requirements. The present study reported the ethnobotanically important resources from the Bana Valley, Azad Jammu and Kashmir, Pakistan, with an aim to analyze and conserve the indigenous traditional knowledge on the utilization of the most commonly used plants by local community.

2. Materials and methods

2.1. Study area, climate and vegetation

Bana Valley is one of the biodiversity-rich area of Azad Jammu and Kashmir. It is located at longitude 73°53'5.316" E and latitude 33°32'9.925" N. The altitude ranges from 500-800 m above sea level. The area falls under dry sub-tropical area, in which *Olea ferruginea* (*O. ferruginea*), *Acacia modesta* (*A. modesta*) and *Pinus roxburghii* (Chir Pine) (*P. roxburghii*) are the most dominant tree species in the area. The vegetation in the area comprises a wide variety of trees, herbs, shrubs and climbers. Ground cover comprises a wide variety of angiosperms along with ferns and mosses. The average annual rainfall in the area is 95.60 mm. The maximum rainfall occurs during July amounting to 251.52 mm, while the least rainfall occurs during November amounting to 14.44 mm. The hottest months of the year are June and July, with mean daily maximum temperature of 37.69 °C and 34.82 °C respectively and minimum temperature of 23.61 °C and 23.62 °C respectively, while the coldest months of a year are December and January with mean maximum temperature of 19.99 °C and 18.09 °C respectively and minimum temperature of 5.49 °C and 4.41 °C respectively. The average maximum and minimum relative humidity of the area is 79.64% and 30.82% respectively.

2.2. Field work and data collection

Field surveys were conducted during August 2012-July 2013 to document ethnobotanical information through designed semi-structured questionnaire and oral interviews of local herbalists (*Hakeems*) and the elderly people who were familiar with traditional uses of plants particularly for medicinal, veterinary, fruit, vegetable, fodder, fuel and other purposes. The queries were repeatedly made to increase the reliability of the data.

2.3. Plant identification

The plant specimens were collected, pressed, dried and mounted on herbarium sheets and identified with the help of floristic literature[34,35]. The correctly identified specimens were deposited in the Department of Botany, Pir Mehr Ali Shah Arid Agriculture University Rawalpindi, Pakistan for record.

3. Results

A total of 86 plant species belonging to 81 genera and 47 families were documented (Table 1); they are used for multi purpose by local people (Table 2). The detailed inventory is provided in Table

3, which includes botanical names, followed by local names, family and ethnobotanical uses.

Of these 86 species, 74 spp. (42.29%) are used in medicine, followed by fodder (34 spp., 19.43%), other uses (26 spp., 14.85%), fuel (20 spp., 11.42%), vegetables (9 spp., 5.14%) timber wood (4 spp., 2.28%), fences (4 spp., 2.28%) and ornamental(4 spp., 2.28%) (Table 2). The most frequently used plant parts are leaves (56 spp., 36.13%), followed by stem (27 spp., 17.42%), whole plant (25 spp., 16.13%), fruit (19 spp., 12.26%), seed (11 spp., 7.09%), roots (7 spp., 4.51%), flower (5 spp., 3.22%), rhizome (2 spp., 1.29%), latex (2 spp., 1.29%) and gums (1 spp., 0.64%). The used medicinal plants included herbs (63 spp., 73.25%), followed by trees (15 spp., 9.30%) and shrubs (8 spp., 18.75%).

Table 1

Distribution of medicinal plant species of Bana Valley according to their family.

Family	No. of species	Family	No. of species
Acanthaceae	2	Malvaceae	3
Adiantaceae	1	Meliaceae	1
Amaranthaceae	3	Mimosaceae	1
Apocynaceae	2	Moraceae	2
Araliaceae	1	Oleaceae	1
Asclepiadaceae	1	Onagraceae	1
Asparagaceae	1	Oxalidaceae	1
Asteraceae	5	Pinaceae	1
Boraginaceae	2	Plantaginaceae	1
Brassicaceae	2	Poaceae	9
Cannabaceae	1	Polygonaceae	2
Commelinaceae	1	Primulaceae	1
Compositae	2	Pteridaceae	1
Convolvulaceae	3	Punicaceae	1
Cyperaceae	2	Ranunculaceae	2
Dryopteridaceae	1	Rhamnaceae	2
Euphorbiaceae	3	Rosaceae	1
Flacourtiaceae	1	Rubiaceae	1
Fumariaceae	1	Sapindaceae	1
Geraniaceae	1	Solanaceae	3
Iridaceae	1	Tiliaceae	1
Lamiaceae	4	Urticaceae	1
Leguminosae	5	Verbenaceae	1
Linaceae	1		

Table 2

Economic classification and use value of plant species of Bana Valley.

Species	Me	Fo	Fu	Tw	Vg	Or	Fe	O	UVI
<i>Acacia nilotica</i> (L.) Delile.	1	1	1	1	0	0	1	1	5
<i>A. modesta</i>	1	1	1	1	0	1	1	1	7
<i>Achyranthes aspera</i> Wall.	1	0	0	0	0	0	0	0	1
<i>Adhatoda zeylanica</i> Medic.	1	0	1	0	0	0	0	1	3
<i>Adiantum incisum</i> Forlk.	1	0	0	0	0	0	0	0	1
<i>Ajuga bracteosa</i> Wall. ex Bath.	1	0	0	0	0	0	0	0	1
<i>Alternanthera pungens</i> Kunth.	1	0	0	0	0	0	0	0	1
<i>Amaranthus viridis</i> L.	1	0	0	0	1	0	0	0	2
<i>Anagallis arvensis</i> L.	1	0	0	0	0	0	0	0	1
<i>Aristida adscensionis</i> L.	0	1	0	0	0	0	0	0	1
<i>Artemisia scoparia</i> Waldst and kit.	1	0	0	0	0	0	0	0	1
<i>Asparagus gracilis</i> Royle.	1	0	0	0	1	0	0	0	2
<i>Bauhinia variegata</i> L.	1	0	1	0	1	0	0	1	4

Me: Medicine; Fo: Fodder; Fu: Fuel; Tw: Timber wood; Vg: Vegetables; Or: Ornamental; Fe: Fencing; O: Other; UVI: Use value index.

Table 2, continued

Economic classification and use value of plant species of Bana Valley.

Species	Me	Fo	Fu	Tw	Vg	Or	Fe	O	UVI
<i>Bombax ceiba</i> L.	1	1	1	0	1	0	0	1	5
<i>Brachiaria eruciformis</i> Sm.	0	1	0	0	0	0	0	0	1
<i>Calotropis procera</i> (Willd.)	1	0	0	0	0	0	0	0	1
<i>Camabis sativa</i> L.	1	1	0	0	0	0	0	0	2
<i>Capsella bursa-pastoris</i> L.	1	0	0	0	0	0	0	0	1
<i>Carissa opaca</i> Stapaf.	1	1	1	0	0	0	0	1	4
<i>Cassia fistula</i> L.	1	1	0	0	0	0	0	0	2
<i>Cuscuta reflexa</i>	1	0	0	0	0	0	0	0	1
<i>Celtis eriocarpa</i> Decne.	1	1	1	0	0	0	0	0	3
<i>Chenopodium album</i> L.	1	1	0	0	1	0	0	1	4
<i>Cichorium intybus</i> L.	1	0	0	0	0	0	0	0	1
<i>Clematis grata</i> Wall.	1	1	0	0	0	0	0	0	2
<i>Commelina benghalensis</i> L.	1	0	0	0	1	0	0	0	2
<i>Convolvulus arvensis</i> L.	1	0	0	0	0	0	0	0	1
<i>Conyza canadensis</i> L.	1	0	0	0	0	0	0	0	1
<i>Cynodon dactylon</i> (L.) Pers.	1	1	0	0	0	0	0	0	2
<i>Cynoglossum lanceolatum</i> Forsk.	1	0	0	0	0	0	0	0	1
<i>Cyperus iria</i> L.	0	1	0	0	0	0	0	0	1
<i>Cyperus rotundus</i> L.	1	0	0	0	0	0	0	0	1
<i>Dalbergia sissoo</i> Roxb.	1	1	1	1	0	0	0	1	5
<i>Dichanthium annulatum</i> Ferrsk.	0	1	0	0	0	0	0	0	1
<i>Dicliptera roxburghiana</i> L.	1	0	0	0	0	0	0	1	2
<i>Dodonaea viscosa</i> (L.) Jacq.	0	0	1	0	0	0	0	0	1
<i>Dryopteris stewartii</i> Fress.	1	1	0	0	1	0	0	1	4
<i>Eragrostis japonica</i> Thunb. Trin.	0	1	0	0	0	0	0	0	1
<i>Eruca sativa</i> Garsault.	1	0	0	0	0	0	0	0	1
<i>Euphorbia helioscopia</i> L.	1	0	0	0	0	0	0	0	1
<i>Euphorbia prostrata</i> Ait.	1	0	0	0	0	0	0	0	1
<i>Ficus palmata</i> Forsk.	1	1	1	0	0	0	0	1	4
<i>Flacourtia indica</i> (Burm.) Merrill.	1	1	1	0	0	0	0	1	4
<i>Fragaria nubicola</i> Lindley.	1	0	0	0	0	0	0	1	2
<i>Fumaria indica</i> (Hauuskn) H.N. Pugsley.	1	1	0	0	0	0	0	0	2
<i>Gallium aparine</i> L.	1	0	0	0	0	0	0	0	1
<i>Geranium rotundifolium</i> L.	1	0	0	0	1	0	0	0	2
<i>Grewia villosa</i> Willd.	1	1	1	0	0	0	0	0	3
<i>Hedera nepalensis</i> K.Koch.	1	0	0	0	0	0	0	0	1
<i>Heteropogon contortus</i> L.	0	1	0	0	0	0	0	0	1
<i>Imperata cylindrica</i> (L.) P. Beauv.	0	1	0	0	0	0	0	0	1
<i>Ipomoea purpurea</i> L.	1	0	0	0	0	0	0	0	1
<i>Iris aitchisonii</i> (Bakar) Boiss.	1	0	0	0	0	0	0	0	1
<i>Linum usitatissimum</i>	1	0	0	0	0	0	0	0	1
<i>Mallotus philippensis</i> (Lam.) Muell.	1	1	1	0	0	1	0	1	5
<i>Malva parviflora</i> L.	1	0	0	0	0	0	0	0	1
<i>Malvastrum coromandelianum</i> L.	1	0	0	0	0	0	0	0	1
<i>Medicago denticulata</i> Willd.	1	1	0	0	0	0	0	0	2
<i>Melia azadirachta</i> (L.) Press.	1	0	1	0	0	0	0	1	3
<i>Mentha longifolia</i> L.	1	0	0	0	0	0	0	1	2
<i>Micromeria biflora</i> Ham.	1	0	0	0	0	0	0	1	2
<i>Morus alba</i> Roxb.	1	1	1	0	0	0	0	1	4
<i>Nerium indicum</i> Mill.	1	0	0	0	0	1	0	1	3
<i>Oenothera rosea</i> L. Her.	0	1	0	0	0	0	0	0	1
<i>O. ferruginea</i>	1	1	1	0	0	0	0	1	4
<i>Oxalis corniculata</i> L.	1	0	0	0	0	0	0	1	2
<i>P. roxburghii</i>	1	0	1	1	0	1	1	0	5
<i>Plantago ovata</i> L.	1	0	0	0	0	0	0	0	1
<i>Poa annua</i> L.	0	1	0	0	0	0	0	0	1
<i>Polygonum plebejum</i> R.Br.	1	0	0	0	0	0	0	0	1
<i>Prunella vulgaris</i> L.	1	0	0	0	0	0	0	0	1
<i>Pteris vittata</i> L.	0	0	0	0	0	0	0	1	1
<i>Punica granatum</i> L.	1	0	1	0	0	0	1	1	4
<i>Physalis divaricata</i> D. Don	1	1	0	0	0	0	0	0	2
<i>Ranunculus muricatus</i> L.	1	0	0	0	0	0	0	0	1
<i>Rumex nepalensis</i> Spreng.	1	1	0	0	0	0	0	0	2
<i>Solanum nigrum</i> L.	1	0	0	0	1	0	0	0	2
<i>Solanum suratense</i> Burm. f.	1	0	0	0	0	0	0	0	1
<i>Sonchus asper</i> Hill.	1	1	0	0	0	0	0	1	3
<i>Taraxacum officinale</i> Weber.	1	0	0	0	0	0	0	0	1
<i>Themeda anathera</i> (Hack.)	0	1	0	0	0	0	0	0	1
<i>Trichodesma indicum</i> (L.) R. Br.	1	0	0	0	0	0	0	0	1
<i>Vitex negundo</i> L.	1	0	1	0	0	0	0	0	2
<i>Xanthium strumarium</i> L.	1	0	0	0	0	0	0	0	1
<i>Ziziphus jujuba</i> Mill.	1	1	1	0	0	0	0	1	4
<i>Ziziphus oxyphylla</i> Edgew.	1	0	0	0	0	0	1	1	3

Me: Medicine; Fo: Fodder; Fu: Fuel; Tw: Timber wood; Vg: Vegetables; Or: Ornamental; Fe: Fencing; O: Other; UVI: Use value index.

Table 3

Ethnobotany of some indigenous plants of Banaha Valley.

Name of species	Family	Pharmacological and biological activities	Ethnobotanical uses
<i>Acacia nilotica</i> (L.) Delile	Mimosaceae	Antibacterial, antioxidant, anti-mutagenic, antipyretic and antiasthmatic, antimicrobial, antifertility, anti-hypertensive and anti-spasmodic	The powder of dry pods and bark is effective for treatment of lumbago, kidney pains, diabetes, sexual disorders, and to dispel phlegm; as tooth powder and as astringent. Leaves and legumes are used as fodder for goats and oxen to increase weight. Seeds are also used for making wine. Wood is used for the construction and fuel purpose.
<i>A. modesta</i>	Leguminosae	Antibacterial, antioxidant, antidiabetic	Fresh branches are used as tooth stick (Miswak) for teeth cleansing. Sweetmeat is formed from gum which is effective for lumbago. Leaves are used as fodder for goat. Flowers are used for honey bee collection. Wood is used as fuel; the branches are used for fencing the fields.
<i>Achyranthes aspera</i> Wall.	Amaranthaceae	Antimicrobial, larvicidal, antifertility, immunostimulant, hypoglycemic, hypolipidemic, anti-inflammatory, antioxidant, diuretic, cardiac stimulant, antihypertensive, anti-anasarca, analgesic, antipyretic, antinociceptive, prothyroidic, antispasmodic and hepatoprotective	Ash of leaves and stem is recommended for piles, kidney stones, skin eruptions and asthma. Decoction of whole plant is used to treat pneumonia. Plant extract is used for dysentery and stomach-ulcer. Fried spines along with sugar are reported to be used in whooping cough by indigenous people.
<i>Adhatoda zeylanica</i> Medic.	Acanthaceae	Antimicrobial, anti-allergic, anti-asthmatic, anti-inflammatory, abortifacient, antifeedant, antimutagenic, antiulcer	Leaves are grinded and dissolved in water and this extract is taken orally in early morning against diabetes, scabies, boils, pimples and other skin diseases. It has drying effect and desi ghee is used during its use. Dried branches are used for fuel. Green leaves are used in producing smoky fire to drive away the insects from cattle.
<i>Adiantum incisum</i> Forllk.	Adiantaceae	Antimicrobial, antioxidant, antidiabetic	The fronds are used as diuretic, astringent, and tonic. They are also used in the treatment of headaches and snake and scorpion stings. Rhizome paste is used to heal cuts and wounds.
<i>Ajuga bracteosa</i> Wall. ex Bath.	Lamiaceae	Anticancer, antimalarial, antimicrobial, antidiabetic, antioxidant, diuretic and stimulant	Fresh plant is dried, powdered and its extract is used before dinner for ulcer, colic and jaundice.
<i>Alternanthera pungens</i> Kunth.	Amaranthaceae	Antimicrobial, antioxidant	Root is used for eye tumor, leaves for diuretic and blood purifier.
<i>Amaranthus viridis</i> L.	Amaranthaceae	Antimicrobial, antioxidant, antidiabetic, antihyperlipidemic	Stem and leaves are cooked as vegetable and used against cough, inflammation and as urinate.
<i>Anagallis arvensis</i> L.	Primulaceae	Analgesic, antimicrobial, antioxidant	Whole plant is acrid, mucilaginous herbs that lowers fever and has diuretic and expectorant effects. Internally used for depression, tuberculosis, liver complaints, epilepsy, dropsy, and rheumatism. Externally extract of this species is used for improving the complexion, especially for freckles.
<i>Aristida adscensionis</i> L.	Poaceae	Antioxidant	Fresh and dry fodder.
<i>Artemisia scoparia</i> Waldst and kit.	Compositae	Anticholesterolemic, antipyretic, antiseptic, antibacterial, cholagogue, diuretic, purgative and vasodilator properties	It is used to treat fever, high blood pressure and skin diseases, and relieve earache.
<i>Asparagus gracilis</i> Royle.	Asparagaceae	Antimicrobial, antioxidant, anti-urease	Whole plant is used as vegetable. Root and flower are used as aphrodisiac.
<i>Bauhinia variegata</i> L.	Leguminosae	Antimicrobial, anticancer, antioxidant, antiulcer and hepatoprotective	Leaves are used as fodder. Flower buds are used as vegetable (Saag). Bark is useful for skin diseases and leprosy. Wood is used as fuel, also cultivated as ornamental plant.
<i>Bombax ceiba</i> L.	Malvaceae	Antimicrobial, antioxidant, anti-inflammatory, anti-obesity, antidiabetic	Buds are used as vegetable for digestive problems. The leaves are used as fodder and branches as fuel. Fruit (matures) excretes silky cotton used for making pillows
<i>Brachiaria eruciformis</i> Sm.	Poaceae	Antioxidant, antibacterial	Fresh and dry fodder.
<i>Calotropis procera</i> (Willd.)	Asclepiadaceae	Anticancer, antifeedant, antifertility, antimicrobial, antioxidant, anti-inflammatory, antidiabetic, hemolytic	The leaves are warmed and tied over the wounds and used as poultice for their quick healing. The latex from stem and leaves is applied upon teeth to get rid of the worms. Extreme care must be taken because latex is extremely poisonous. Latex is applied externally on skin diseases.
<i>Cannabis sativa</i> L.	Cannabaceae	Analgesic, anticonvulsant, antiasthmatic, antitumor, antimicrobial, antioxidant, sedative, anti-inflammatory, bone stimulant, antidiuretic, anti nausea	This plant has sedative property and used in vigor medicines. Flatulency of buffaloes is treated by this plant in the form of fodder.
<i>Capsella bursa-pastoris</i> L.	Brassicaceae	Analgesic, antipyretic, anti-inflammatory, antineoplastic, antitumor, anticancer	Paste of fresh leaves with milk for curing diarrhea; seeds are stimulant and diuretic
<i>Carissa opaca</i> Stapaf.	Apocynaceae	Antioxidant, antimicrobial, antidiabetic, antitumor	Decoction of fresh leaves is used against hepatitis and jaundice. Fruits are edible and used as digestive stimulant. Fruits are edible and also sold by poor people for generating their income. Dried branches are used for fuel and the leaves are browsed by goats.
<i>Cassia fistula</i> L.	Leguminosae	Abortifacient, anti-allergenic, antidiabetic, anti-inflammatory, antioxidant, hypoglycemic, astringent	The pulp of fruits is used against constipation. Leaves are used as fodder and dried branches are used for fuel. Pulp of fruits is also used to relieve constipation in cattle.
<i>Cuscuta reflexa</i>	Convolvulaceae	Antioxidant, antimicrobial, antidiabetic, analgesic, antifertility	Whole plant is used for anti-lice, anti-anemia, also used in skin diseases and other weaknesses of children.
<i>Celtis eriocarpa</i> Decne.	Urticaceae	Antifertility, laxative, astringent, antioxiant	Seeds and leaves are used as fodder for goat and sheep. Wood is used as fuel. Bark is ground and mixed to form powder to use for tumor, scabies and other skin diseases. Seeds are also used in dysentery.
<i>Chenopodium album</i> L.	Asteraceae	Hypoglycemic, antibacterial, spasmolytic, antipruritic, anti-inflammatory, hepatoprotective, antioxidant, anticancer	Leaf and flower is used as vegetable and fodder. Leaves also have laxative and anthelmintic properties.
<i>Cichorium intybus</i> L.	Asteraceae	Anti-malarial, anti-fungal, gastroprotective, antihelmintic, analgesic, anti-ulcer, hepatoprotective, antibacterial, antioxidant	Extract of leaves along with lemonade is used against chronic gastritis, and as liver tonic, diuretic, and to relieve jaundice and dropsy.
<i>Clematis grata</i> Wall.	Ranunculaceae	Antioxidant, demulcent, emollient, refrigerant, laxative, hypotensive, depressant, diuretic	Leaves are used as a fresh fodder. Leaves when chopped and smelled will cause nausea.
<i>Commelina benghalensis</i> L.	Commelinaceae	Antioxidant, demulcent, emollient, refrigerant, laxative, hypotensive, depressant, diuretic	Leaves are used as vegetable and used in treating bedsores, breast sores and pimples.
<i>Convolvulus arvensis</i> L.	Convolvulaceae	Antioxidant, diuretic, immunostimulant, hypoglycemic, antihemorrhagic, antibacterial and antifugal	Whole plant is purgative, also applied in skin disorders.
<i>Conyza canadensis</i> L.	Asteraceae	Anthelmintic, antiaggregant, anticonvulsant, antioxidant, anti-inflammatory, astringent	Used as a fresh fodder and has diuretic and stimulant properties.
<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Antidiabetic, antioxidant, immunomodulator, diuretic, anti-emetic	Aerial parts are crushed and paste is applied on skin infection, injuries and eczema. It is also used as fodder.
<i>Cynoglossum lanceolatum</i> Forrsk.	Boraginaceae	Antioxidant	Powdered plant is taken with a decoction of <i>Coriandrum sativum</i> fruits as laxative.
<i>Cyperus iria</i> L.	Cyperaceae	Antioxidant, antibacterial, antidiabetic	Used as a fodder
<i>Cyperus rotundus</i> L.	Cyperaceae	Antidiabetic, antiarrhoeal, cytoprotective, antimutagenic, antioxidant, antimalarial, anti-inflammatory, antipyretic and analgesic	Rhizome of this plant is used to cure stomach diseases. It is crushed and ground to make powder. By mixing in water it is used thrice a day.
<i>Dalbergia sissoo</i> Roxb.	Leguminosae	Antipyretic, analgesic, anti-inflammatory, antimicrobial, aperitif, aphrodisiac, expectorant, refrigerant	The fruits are grinded and are used against bloody diarrhoea. Leaves and branches are used as fodder. Wood is used for making furniture, fuel wood and house construction. Branches are used as Muswak (tooth brush) and kill worms in the teeth.
<i>Dichanthium annulatum</i> Ferrsk.	Poaceae	Antioxidant, antimicrobial	Fresh and dry fodder
<i>Dicliptera roxburghiana</i> L.	Acanthaceae	Antioxidant, antimicrobial, antidiabetic	The powder is used as general tonic. Whole plant is used to avoid sun stroke in buffaloes.
<i>Ziziphus jujuba</i> Mill.	Rhamnaceae	Antifungal, Antibacterial, Antiulcer, Anti-inflammatory, Cognitive, Antispastic, Antifertility/contraception, Hypotensive and Antinephritic, Cardiotonic, Antioxidant, Immunostimulant, and Wound healing	Wood is used as a fuel wood. It is also used in local furniture like beds. The leaves are used for fodder for goat. Fruit is edible, blood purifier and used in indigestion. Fruit and leaves decoction is excellent hair wash. Bark is mixed with milk and honey to use in diarrhea and dysentery.
<i>Ziziphus oxyphylla</i> Edgew.	Rhamnaceae	Antioxidant, antidiabetic, antimicrobial	Grinded roots are also used against jaundice. Roots are boiled in water to get decoction which is used against scabies, pustules and diabetes. Fruits are edible and leaves are browsed by goats. Spiny branches are used in fencing the fields.

Table 3, continued

Ethnobotany of some indigenous plants of Banaha Valley.

Name of species	Family	Pharmacological and biological activities	Ethnobotanical uses
<i>Dodonaea viscosa</i> (L.) Jacq.	Sapindaceae	Antibacterial, antifungal, anti-inflammatory, anti-oxidant	Commonly used as fuel wood for producing heat without smoke
<i>Dryopteris stewartii</i> Press.	Dryopteridaceae	Antibacterial, antioxidant	Collection of young leaves is made in spring season and used as vegetable that is found effective in gastric ulcer and constipation. Leaves are used as fodder.
<i>Eragrostis japonica</i> Thunb. Trin.	Poaceae	Antioxidant	Dry and fresh fodder
<i>Erica sativa</i> Garsault.	Brassicaceae	Antitumor, antidiabetic, antihypertensive, antioxidative and antibacterial	Whole plant is used as blood purifier and also used as fodder for cattle, oil for cooking, massage and to remove dandruff in hair.
<i>Euphorbia helioscopia</i> L.	Euphorbiaceae	Antioxidant, antimalarial, antibacteria	Milky latex is applied on cuts. Diluted latex is used as eye drops against eye problems.
<i>Euphorbia prostrata</i> Ait.	Euphorbiaceae	Antioxidant, antimicrobial	Whole plant is crushed and given with water to buffaloes to cure fever. This crushed form of plant when mixed with butter is remedy for jaundice.
<i>Ficus palmata</i> Forrsk.	Moraceae	Antimicrobia, antioxidant, anticarcinogenic, antiproliferative	Leaves are used as fodder for goat. Fruit is edible and laxative. It soothes the bee sting by simple rubbing on the skin. Wood is hard and used for making household utensils. It is also used as fuel wood.
<i>Flacourtia indica</i> (Burm.) Merrill.	Flacourtiaceae	Antioxidant, antimicrobial, antidiabetic	Fruit is edible and are also used against diabetes. Leaves are used as fodder and dried branches are used for fuel wood.
<i>Fragaria nubicola</i> Lindley.	Rosaceae	Antioxidant, antimicrobial	Fruit is edible and has a very pleasant strawberry flavor. Plant juice is used to treat profuse menstruation and tongue blemishes. The fruit mixed with <i>Berberis lyceum</i> leaves is used to treat stomach ulcers and as an antiseptic. Leaves are mildly astringent and diuretic, used in children's diarrhea and infections of the urinary organs. Tea is prepared from the roots and leaves.
<i>Fumaria indica</i> (Hausskn.) H.N. Pugsley.	Fumariaceae	Antioxidant, antimicrobial, antidiabetic, analgesic	The plant is diuretic, diaphoretic and aperient. An extract is used for cooling purpose, used externally also for the same purpose. Leaves are used as fodder
<i>Gallium aparine</i> L.	Rubiaceae	Antioxidant, antimicrobial, antidiabetic	Leaves are used in treatment of jaundice. Poultice made up of leaf paste is externally applied on wounds as an antiseptic.
<i>Geranium rotundifolium</i> L.	Geraniaceae	Antioxidant, antimicrobial	Whole plant is cooked after drying and is eaten to cure constipation.
<i>Grewia villosa</i> Willd.	Tiliaceae	Antioxidant, antipyretic, analgesic	Leaves are given to cattle especially during delivery for quick discharge of afterbirth. It is also given to young animals to induce puberty. Leaves are highly palatable for goat. Wood is used as fuel wood.
<i>Hedera nepalensis</i> K.Koch.	Araliaceae	Antipyretic, antidiabetic	Juice from leaves is used for curing diabetes, also considered as blood purifier.
<i>Heteropogon contortus</i> L.	Poaceae	Antioxidant, anti-inflammatory	Dry and fresh fodder
<i>Imperata cylindrica</i> (L.) P. Beauv.	Poaceae	Antioxidant, analgesic, anti-inflammatory	Dry and fresh fodder
<i>Ipomoea purpurea</i> L.	Convolvulaceae	Antimicrobial, antioxidant, antidiabetic	Used in bronchitis and as ornamental plant
<i>Iris aitchisonii</i> (Bakar.) Boiss.	Iridaceae	Antimicrobial, antioxidant	Used as diuretic and cathartic, but is toxic and should be used very carefully.
<i>Linum usitatissimum</i>	Linaceae	Antimicrobial, antioxidant, antidiabetic, antihyperlipidemic	Anti-oxidant, anti-diabetic, anti-arthritis, anti-asthmatic, anti-allergic, anti-inflammatory and also used for heart diseases
<i>Mallotus philippensis</i> Lamk. Muell.	Euphorbiaceae	Antidiabetic, antioxidant, antimicrobial	The fruits are crushed and used orally to treat bloody diarrhoea. The leaves are used as "Koochan" to wash utensils. The leaves are used as fodder and branches for fuel.
<i>Malva parviflora</i> L.	Malvaceae	Antidiabetic, antioxidant, antimicrobial	The seeds are used to relieve cough and ulcer in the bladder. The decoction of the leaf is a remedy for tape worm and profuse menstruation.
<i>Malvastrum coromandelianum</i> L.	Malvaceae	Antidiabetic, antioxidant, antimicrobial, antidiabetic, antioxidant, antimicrobial	Fresh leaves are crushed and are used to treat diabetes. Seeds are used for curing leprosy.
<i>Medicago denticulata</i> Willd.	Leguminosae	Antioxidant, anti-inflammatory, antiasthmatic, antimicrobial	Used as pot herb and fodder for cattle
<i>Melia azadirachta</i> L. Press.	Meliaceae	Antioxidant, antimicrobial, anti-inflammatory, cardioprotective, analgesic, anticancer, antiulcer, antipyretic, antiplasmodial	Wood is used as fuel. Dried fruits are powdered, mixed with yogurt and used as purgative and anthelmintic for animals, especially for tape-worms. Fruit powder is used for skin diseases. Young leaves are edible.
<i>Mentha longifolia</i> L.	Lamiaceae	Antidiabetic, antioxidant, antimicrobial	Used as a pot herb, flavoring agent, also used as carminative, and for cholera and digestive problems.
<i>Micromeria biflora</i> Ham.	Lamiaceae	Antioxidant, antimicrobial	The dried flowers and young leaves are used to make tea and a flavoring agent in curries and soups. Root paste is used for toothaches and as a poultice to treat wounds.
<i>Morus alba</i> Roxb.	Moraceae	Antidiabetic, antimicrobial, antimutagenic, antioxidant, anticancer, anxiolytic, anthelmintic, antistress, immunomodulatory, hypocholesterolemic, nephroprotective, hepatoprotective	Leaves are palatable and used as fodder for goat and silk worms. Fruit is dried and sold in market as a dry fruit. Fresh fruit is ground and used as tonic and for throat irritation. Wood is used for making agricultural tools and furniture. Wood is also used as fuel.
<i>Nerium indicum</i> Mill.	Apocynaceae	Antioxidant, antimicrobial, antimalarial, analgesic, antiulcer, anti-inflammatory	The branches are used as Miswak (toothbrush) to get rid of worms, but the liquid extract of the branches and leaves is highly poisonous, so it should not be taken orally and extreme care should be taken. The plant is used as ornamental due to its beautiful flowering.
<i>Oenothera rosea</i> L. Her.	Onagraceae	Antithrombic, antitumor, astringent demulcent, depurative, hypocholesterolemic, hypotensive, lacrimatory, nutritive, sedative, vasodilator	Used as a fodder
<i>O. ferruginea</i>	Oleaceae	Antiaggregant, antiarrhythmic, antibacterial, antidote, antioxidant, antipyretic, antisclerotic, antispasmodic, astringent, cardioprotective, cholagogue	Small leaves are used as herbal tea for cure of digestive complaints. Branches and trees are generally used for fuel wood, timber and preparation of agricultural tools. Cuttings of young stem are used as Miswak (toothbrush).
<i>Oxalis corniculata</i> L.	Oxalidaceae	Antioxidant, anticancer, anthelmintic, anti-inflammatory, analgesic, steroidogenic, antimicrobial, antiamoebic, antifungal, astringent, depurative, diuretic, emmenagogue, febrifuge, cardio relaxan, stomachic and styptic	Leaves are cooked as vegetables. Plant extract with butter is applied externally to swellings, pimples and boils. Decoctions are taken for treating scurvy and children ringworms. Leaf juice is used to treat skin infections, insect bites and burns.
<i>P. roxburghii</i>	Pinaceae	Antioxidant, anticancer, antibacterial, antiseptic, diuretic	Juvenile apex of the stem is grinded and used against bloody diarrhoea. Tuberculosis patients are advised to keep sitting under its shade for quick recovery. The wood of the plant is used for timber and fuel purpose. The resin obtained is used in soap industry. The seeds are edible. Dried leaves and logs are used in roof thatching. The heartwood is highly inflammable and its small pieces are used for ignition purpose at homes.
<i>Plantago ovata</i> L.	Plantaginaceae	Antioxidant, antimicrobial	Seed and fruits are laxative and used for stomachic and intestinal problem
<i>Poa annua</i> L.	Poaceae	Antioxidant and antimicrobial	Used as cattle fodder
<i>Polygonum plebejum</i> R.Br.	Polygonaceae	Antioxidant, antimicrobial, anticancer	Juice is used in ophthalmic disorders of domestic birds and shows amazing results
<i>Prunella vulgaris</i> L.	Lamiaceae	Antioxidant, antiviral, immunomodulatory and antiproliferative, antidiabetic	The seeds are antipyretic, laxative, tonic, and diuretic, useful in inflammation, diseases of heart, difficult breathing, weakness of eyesight due to over age. Used by tribes as expectorant and antispasmodic. The plant is used for curing fever and cough.
<i>Pteris vittata</i> L.	Pteridaceae	Antioxidant, antiviral, antimicrobial	Used for bioremediation
<i>Punica granatum</i> L.	Punicaceae	Antioxidant, anti-atherosclerotic, antibacterial and antiviral	The seeds are used to make "Chattni" which is a digestive stimulant. Its seeds are highly carminative. Extract of seeds has cooling effect and is especially used in summer. The rind of fruits is dried, powdered and mixed with sugar and used against diarrhoea for both humans and cattle. Branches are used for fuel and also for fencing the fields. Seeds are edible.

Table 3, continued

Ethnobotany of some indigenous plants of Banaha Valley.

Name of species	Family	Pharmacological and biological activities	Ethnobotanical uses
<i>Physalis divaricata</i> D. Don.	Solanaceae	Antioxidant, antibacterial	Whole plant is used as fresh fodder for cattle. Fruit is used as diuretic and tonic.
<i>Ranunculus muricatus</i> L.	Ranunculaceae	Antioxidant, antibacterial, antihemorrhagic, cytotoxic	The plant is used in the treatment of intermittent fevers, gout and asthma. A decoction of the plant is used as a purgative for goats.
<i>Rumex nepalensis</i> Spreng.	Polygonaceae	Antioxidant, antibacterial,	The extract of the leaves is used as antiseptic against wounds and skin problems. Young leaves are used as vegetable.
<i>Solanum nigrum</i> L.	Solanaceae	Antioxidant, anti-inflammatory, hepatoprotective, diuretic, and antipyretic agent, antibacterial, mycotic infection, cytotoxic, anti-convulsant	Fresh leaves and stem after cooking are used for treatment of diabetes.
<i>Solanum surattense</i> Burm. f.	Solanaceae	Antioxidant, antimicrobial, leishmanicidal	The extract of leaves is applied on body swellings to get relief. Its seeds are burnt in "Chehlum" and the smoke is inhaled to get relief from toothach. Fruits and leaves are boiled and the decoction is mixed in water and used for taking bath against skin diseases.
<i>Sonchus asper</i> Hill.	Asteraceae	Antioxidant, antimicrobial	Decoction of leaves and roots is taken orally against fever. Shoots are fed to livestock for enhancing lactation. It is also used against pimples, diabetes, scabies and other skin problems. The plant is also used as fodder.
<i>Taraxacum officinale</i> Weber.	Asteraceae	Antioxidant, antimicrobial	It is effective as a diuretic. Root is depurative, strongly diuretic, laxative, stomachic and tonic. The tea made up of flowers is used internally in the treatment of urinary disorders, gallstones and jaundice. Distilled water made from the ligules is cosmetically used to clear the skin and is very effective in fading freckle.
<i>Themeda anathera</i> (Hack.)	Poaceae	Antioxidant and antibacterial	Fresh and dry fodder
<i>Trichodesma indicum</i> (L.) R. Br.	Boraginaceae	Antioxidant, antimicrobial	The leaves paste is mixed with water and brown sugar and given orally against diarrhoea and dysentery.
<i>Vitex negundo</i> L.	Verbenaceae	Antidibetic, antibacterial, antioxidant	The fresh leaves are aromatic, tonic, febrifuge, diuretic and anthelmintic. Dried leaves are smoked for relief of headache. Branches are used as a fuel wood. The flowers are astringent and tonic.
<i>Xanthium strumarium</i> L.	Compositae	Antibacterial, antitumour, antitussive, antifungal, anti-inflammatory, antinociceptive, hypoglycaemic, antimutagenic, antioxidant	Decoction is administered for long standing cases of material fever. Prickly fruit is considered as coolant and demulcent and given in small-pox.

4. Discussion

The human history would be incomplete without the plants[36]. Since the beginning of civilization, people have used plants for accomplishing various daily life requirements. The plant resources lead to the economical wealth of an area. The utility and use of plants create the importance of plant in that area[29,31]. Within the same context, it was found that the people of the study area depend on the native plants for meeting their basic requirements such as fodder, medicines, fuel, fruits, vegetables, furniture, roof thatching, etc. One of the major reasons could be that the whole area is rural in nature and most of the people are not very well off. Therefore, most of them keep livestock as the source of income to keep their live.

Ethnobotanical uses of plants in the present study shows that major proportion of species were used for medicinal purpose (74 spp; 42.29%). A large proportion of the population, living in remote areas, rely on medicinal plants for health, such as *Justicia adhatoda*, *Acacia nilotica*, *Calotropis procera*, *Ricinus communis*, *Morus nigra*, *Dodonaea viscosa*, *Achyranthus aspera*, *Ipomoea carnea*, *Taraxacum officinale*, *Eriobotrya japonica*, *Cissus carnosa*, *Melia azedarach*, *Eucalyptus citriodora* and *Ficus carica*, to meet almost every need of their lives. Similar reports have come from nearby areas of Azad Kashmir such as District Muzaffarabad[37], Samahni Valley, District Bhimber[38], and Poonch Valley and Nikyal valley[28,29]. Exploitation of medicinal plants by locals, collectors and herbal drug dealers was increasing with increasing demand of pharmaceutical industry. This caused drastic decrease in the occurrence and products of medicinal plants. Grazing, browsing, deforestation and soil erosion were mainly responsible for reduction in the medicinal flora. It is therefore essential to have conservation strategies for these medicinal plants. Due to overexploitation, only remnant vegetation remained growing at high elevation, where man and grazing animals cannot reach easily. The increasing population has pressurized the medicinal plant which has dramatically decreased the species and population of medicinal plants[28]. The nomads collect the medicinal plants for their earning. They uproot and collect each

part of the medicinal plants in non scientific way. Prior to this study, no reference exist on the medicinal plant of this area. Most species in the present study have also been reported as medicinal plants by some other researchers[2,39-44]. The observations from the local communities were that the richness and diversity of medicinal plants was decreasing at the same time and the percentage of plants used as medicine was steadily increased with increasing awareness in Banaha Valley. The questionnaires data indicated that the number of people with sound knowledge of herbal drugs is declining because of a shift to Western medicines. It is feared that knowledge of traditional uses of plants may be lost. It is therefore imperative to study and record uses of plants in a scientific manner. Such studies may also provide information to biochemists and pharmacologists for screening of individual species and for rapid assessment of phytochemical constituents. Local people use plants for medication, food, fodder for cattle, and even as cosmetics. The number of women using allopathic medicines is negligible because of their dependence on medicines from local plants. These plants are also a source of interaction between the women and the natural resources of the area. It is very important that the precious ethnobotanical knowledge about the plants (which is disappearing very fast) should be transferred to the younger generation[27].

The second major utility of plants was as fodder (34 spp., 19.43%). The area is a rangeland blessed with high number of palatable species, so there is great potential for livestock farming. Deforestation, overgrazing and soil erosion were the main factors responsible for the reduction of medicinal plant in this area. The local live stocks grazed most of the medicinal plant. It is therefore essential to have conservation strategies for these medicinal plants. The collection of plant must be correlated with the phonological cycle. The plants are grazed and collected for medicinal or fuel wood purpose. Similarly, the plants grazed or collected for root, rhizome, bulb and flower become more threatened. The shoots fail to develop seed and flowers while the rhizomatous plants are destructively collected. This will reduce the chance of their regeneration. As a result, highly nutritious and palatable species are being gradually replaced with less palatable ones. One of the effective solutions is the rotational grazing, which will be very

helpful in conservation practices. It is the need of the hour to focus an immediate attention on plant conservation from the government and non-governmental organization with the help of local people by creating awareness in them.

In the investigated area, most people are poor and lack the basic facilities. They depend upon the forest for fuel wood. There are 20 (11.42%) species used for fuel wood. Virtually any woody species is being used as fuel wood in the study area. *O. ferruginea*, *A. modesta*, *Dalbergia sissoo*, *Punica granatum*, *P. roxburghii*, *Dodonaea viscosa*, *Carissa opaca* and *Zizyphus nummularia* were popular fuel wood species in the area. Some researchers stated that most of the species that were preferred for fuel wood were therefore under heavy stress, and this statement is similar to present findings[11,25,45,46]. Use of plants as fuel wood from adjoining areas has been reported by other workers[25,42-45]. Fuel wood is likely one of the main causes of forest destruction in the study area, because the winter season is long and very harsh. People need fuel for heating and cooking. The most often reported fuel woods are *Dalbergia sissoo* and *P. roxburghii*. Similar study was conducted by Shinwari and Khan in Margalla Hills National Park[47], who reported a number of species under high pressure of over-exploitation. The leading threat to the trees and shrubs of the Sulaiman Range is the fuel shortage, and during long and severe winter season a huge amount of wood is used as fuel. The furniture wood consisting of *P. roxburghii* is also valuable source to meet their demands. Some of these plants with similar uses have been reported previously[28-30,48,49].

Timber wood harvest from forest resources has become one of the major ecological problems. In recent times, there is pressure on species for burning and construction material. This has led to emergence of barren areas. Building timber plantations will not replace the current ecosystem benefits. Previous studies have suggested that shifts from subsistence agriculture to cash crops have adversely affected labor, the economic status, and natural productivity in other parts of world[50]. Plants such as *Dalbergia sissoo*, *Ficus palmata* and *P. roxburghii* and *A. modesta* are highly valuable as timber wood with high selling and buying prices. The researchers observed that increased human population has resulted in increased demands for natural resources[51], leading to severe resource depletion, especially deforestation for fuel and timber wood in Siran Valley, Pakistan, which is in line with the present study. The low proportion of forest land and continuing degradation of existing forest cover are serious threats to the sustainability of forestry in Pakistan, which is also true in the present study[52].

Conflict of interest statement

I declare that I have no conflict of interest.

Comments

Background

The investigation of the cultural values of plant species plays a significant role in modern medicine, farming, pharmaceutical and nutraceutical industrial sectors of a society. Ethnobotanical approaches are significant in highlighting locally important plant species, particularly for new crude drugs. Documentation of indigenous knowledge, in particular the medicinal values of plant species, provides various vital modern drugs.

Research frontiers

The present work documents the medicinal and other folk uses of native plants of the area with a view to preserve the ethnobotanical knowledge of Bana Valley of district of Kotli-Azad Jammu Kashmir and to develop an ethnobotanical inventory of the species diversity.

Related reports

The ethnobotany of different part of the world and Pakistan has been reported by different researchers. With reference to ethnobotany of Azad Jammu and Kashmir, some studies are reported from different parts.

Innovations and breakthroughs

This manuscript reports the first ethnobotanical study in Bana Valley of district of Kotli-Azad Jammu Kashmir and provides significant information on medicinal plants use among the native people of the area.

Applications

The current research contributes a huge lump of ethnobotanical knowledge and depicts strong human plant interaction. It is an urgent need to document indigenous uses of plants for future domestication.

Peer review

This is a valuable research work about ethnobotanical uses of plants in Bana Valley. Author provides significant information on medicinal plants use among the native people of this region.

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