



Regular article

Analysis of plant resources and diversity in Balluk Mountain, Xinjiang Uygur Autonomous Region

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Abstract

Balluk Mountain is located between the Tianshan Mountains and the Altai Mountains in Xinjiang Province. Influenced by the humid air and diverse landforms of Lake Alacuri, the unique climate of Mount Baluk nourishes excellent pastures and supports numerous wildlife, making it rich in plant resources. The 9th Shenyang Pharmaceutical University Chinese Medicine Resources Scientific Expedition Team conducted field investigations, literature reviews, and specimen identification to study the plant resources and diversity of Balluk Mountain in Xinjiang Province. A total of 235 species of medicinal plants belonging to 59 families and 159 genera were collected during the period from July to August 2015 in this area. The dominant families observed were *Asteraceae*, *Caryophyllaceae*, *Lamiaceae*, *Ranunculaceae*, *Rosaceae* and *Umbelliferae*, with 35, 11, 14, 12, 27, and 13 species respectively. These families account for over 47.4% of the total species collected, though comprising only 10.2% of the total number of families. At the genus level, *Artemisia* was found to be the most dominant genus with eight species, contributing to 0.63% of the total genera, while representing 3.4% of the total species abundance. Overall, this study provides an updated analysis of the plant resources and diversity in Balluk Mountain. Several species have been identified to possess significant medicinal properties and hold potential for various research fields, including natural product chemistry and drug development. The study also offers practical and meaningful suggestions for strengthening the protection and utilization of plant resources in the area. By implementing these suggestions, we can better preserve the plant diversity in Balluk Mountain and ensure the sustainable use of these valuable resources.

Keywords: plant resources; diversity; medicinal use; protection and utilization; Balluk Mountain

1 Introduction

Biodiversity, encompassing biological species, intraspecific genetic variation, and their living

environment, is the prerequisite for the survival of creatures and the foundation for sustainable economic development [1]. Maintaining biodiversity and ensuring the sustainable utilization of biological resources are important responsibilities of people all over the world. Moreover, certain plants within this biodiversity possess significant medicinal value, rendering their protection even more crucial.

The Balluk Mountain Nature Reserve in Xinjiang is renowned as a haven for wildlife and

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flora, making it an important part of conservation efforts. Nestled between the majestic Tianshan Mountains and the Altai Mountains, Balluk Mountain benefits from its unique geographical position. The area is characterized by diverse landforms and is influenced by the humid air and varying climates associated with Lake Alacuri nearby. The geographical location of Balluk Mountain plays a significant role in shaping its distinct climate and ecological conditions. The region experiences a mix of continental and alpine climates, with hot summers and cold winters. These climatic factors, combined with the availability of water resources from lakes and rivers, contribute to the formation of rich and diverse habitats, fostering the growth and development of a wide array of plant and animal species.

As of 2015, the reserve was home to 81 families, 444 genera, and 1244 species of higher plants, as well as 29 families, 51 genera, and 80 species of bryophytes. The recognition of the importance of biodiversity conservation has sparked ongoing efforts to safeguard the unique flora and fauna found in the area. The preservation of biological species, intraspecific genetic variation, and their living environments is deemed crucial for the long-term survival of various organisms, constituting a fundamental requirement for sustainable economic development. Moreover, the significance of plant resources in Balluk Mountain extends beyond ecological conservation. With over 1000 plant species present, a considerable number possess remarkable medicinal properties, being highly valued in traditional medicine. This additional dimension further underscores the imperative for robust protection measures and the implementation of sustainable management practices.

Despite its favorable ecosystem, Balluk Mountain still harbors more than 65 endangered and rare plant species, including European viburnum, Xueling spruce, Tianshan cherry, wild almond, wild

apple, wild rose, fritillaria, root peony, and ferulae. Increasing attention has been directed towards these species, leading to the establishment of a 24000 mu wild almond apricot forest, the world's largest area dedicated to wild almonds, within the Balluk Mountain National Nature Reserve. This initiative has made significant contributions to both scientific research and ecosystem protection [2,3]. However, many other plant species in the area have not received adequate attention, particularly those threatened by both natural and human factors. Consequently, the development and updating of existing plants and resources are paramount to maintaining the area's high biodiversity and a healthy ecosystem in Balluk Mountain.

In 2015, the 9th Scientific Expedition Team of Chinese Medicine Resources of Shenyang Pharmaceutical University conducted an extensive study, updating the plant species in Balluk Mountain. Field investigations, specimen collection, literature retrieval, and specimen checking were employed to conduct a comprehensive survey on resources and biodiversity. The aim was to understand the types, distribution, and utilization of plant resources in Balluk Mountain, providing a scientific foundation for the rational construction and sustainable utilization of these precious plant resources.

2 Materials and methods

2.1 Overview of Balluk Mountain

Balluk Mountain National Nature Reserve, located between the Tianshan Mountains and the Altai Mountains in Xinjiang Province, is a first-level forest reserve at the national level. Its geographical coordinates range from 82°26'-83°13' east longitude to 45°42'-46°03' north latitude. Covering a total area of 115,037.3 hectares. Xinjiang Balluk Mountain National Nature Reserve stretches across Yumin and



Tuoli counties from east to west, spanning a distance of 250 km with a maximum width of 80 km. The average altitude of the reserve is over 2,000 m, with the highest peak reaching 3,253 m above sea level. The reserve experiences a typical continental temperate semi-desert climate. The northern region receives slightly more precipitation compared to the southeast, influenced by the moisture flow from the Arctic Ocean. In contrast, the southeast is affected by hot air flows from the desertification in the eastern basin, resulting in an extremely arid climate. The average annual temperature is 6.2 °C, with the highest recorded temperature of 38.6 °C and the lowest recorded temperature of -35.9 °C. The annual precipitation measures 289.2 mm, while the annual evaporation amounts to 1,882.7 mm [2].

Balluk Mountain Nature Reserve is a paradise for the gene pool of plant species. There are 24 rivers in this area, including the well-known Tast River and Burgunr River, which flow in opposite directions and extend beyond national borders. Balluk Mountain showcases different landforms, such as mountains, hills, valleys, and plains. The unique climate, influenced by the humid air and varied landforms of Lake Alacuri, provides favorable conditions for lush pastures and a thriving wildlife population, resulting in a rich repository of plant resources. With all of these factors considered, Balluk Mountain National Nature Reserve plays an invaluable role in safeguarding rare and endangered plant species, maintaining regional biodiversity, promoting the sustainable development of the local social economy, and enhancing the surrounding ecosystem. It is worth noting that Balluk Mountain boasts an extensive range of plant species, encompassing almost all the different species found in Xinjiang. This characteristic makes the reserve an ideal location for conducting research on plant resources and diversity, offering unique opportunities for scientific exploration and conservation efforts.

2.2 Research method

During the period from July to August 2015, the 9th Scientific Expedition Team of Chinese Medicine Resources from Shenyang Pharmaceutical University, along with the Tongyan four-wheel drive team from Tongji University, conducted plant inspections within the territory of Balluk Mountain. This particular time frame was chosen due to its favorable conditions for plant growth and the convenience for observation and recording. Based on the topography, landforms, altitudes, and plant types found in different regions of Balluk Mountain, scientific expeditions were carried out in various areas, including Yumin County (Tusti River Valley), Tuoli County, Yumin County (Wild Almond Reserve), Antler Bay in Shawan County, and Glacier 1 mountain. These representative areas were surveyed systematically along specific routes. Samples were collected, photographs were taken, and detailed information such as the collection location, time, main morphological characteristics of the plants, and latitude and longitude coordinates was recorded using a GPS logger.

To successfully identify the plant species collected from Balluk Mountain in Xinjiang Province, extensive research was conducted by referencing the “Flora of China” (http://www.efloras.org/flora_page.aspx?flora_id=2) and seeking assistance from Professor Barnuy, an expert in Xinjiang endemic plants from Xinjiang University. Finally, a total of 361 different plant species were successfully identified from Balluk Mountain and Glacier 1 mountain, with the collection altitudes ranging from 1,000 to 4,250 m.

Based on references such as the “National Compilation of Chinese Herbal Medicine”, “Chinese Materia Medica”, “Jingzhu Materia Medica”, “Chinese Tibetan Medicine”, and the “Flora of China” (http://www.efloras.org/flora_page).



aspx?flora_id=2) [4-6], a total of 235 plant species have been identified with medicinal value in Balluk Mountain. These species belong to 52 families and 159 genera.

3 Results

3.1 Analysis of plant family and genera composition in Balluk Mountain

In total, we collected 59 plant families from Xinjiang’s Balluk Mountain. As shown in Fig. 1, the majority of these families have a small number

of species. Specifically, 47 of the collected plant families have only 1-5 species, which accounts for 79.7% of the total number of families. Additionally, 12 families consist of 6-10 species, making up 20.3% of the total. On the other hand, there are only 6 families with more than 10 species. These families are *Asteraceae*, *Caryophyllaceae*, *Lamiaceae*, *Ranunculaceae*, *Rosaceae* and *Umbelliferae*, containing 35, 11, 14, 12, 27, and 13 species, respectively. Although these 6 families account for only 10.2% of the total number of families, their species occupancy rate exceeds 47.4% among all the recorded species.

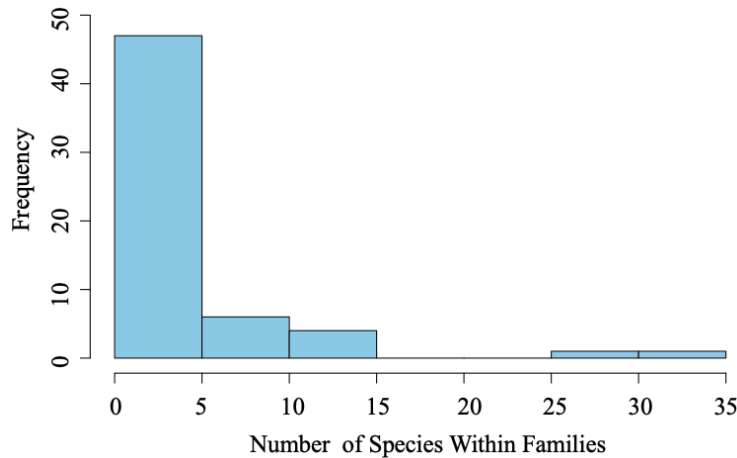


Fig. 1 Species in different families of plants in Balluk Mountain

Regarding genera, a total of 159 genera were collected. Fig. 2 shows that the distribution of genera is fairly even, with no clear dominance. Most genera have only 1-5 species, and only one genus, *Artemisia*, has 8 species.

Out of the 159 plants, 114 genera consist of only one species, accounting for 79.7% of the total genera and 48.5% of the total species. Additionally, 36 genera contain 2-5 species, representing 34.0% of the total genera. However, these genera account for a relatively large proportion of the total number of species, encompassing 65.1% of all recorded species. Moreover, there is only one genus, *Artemisia*, that has 8 species. Although it comprises only 0.63% of the total collected genera, it contributes to 3.4% of

the total species abundance.

3.2 Diversity analysis of medicinal plants in Balluk Mountain

In general, our research in 2015 updated the medicinal plant resources in Balluk Mountain, recording a total of 59 families, 159 genera, and 235 species. The primary families identified were *Asteraceae* (35), *Caryophyllaceae* (11), *Lamiaceae* (14), *Ranunculaceae* (12), *Rosaceae* (27) and *Umbelliferae* (13). These families accounted for 14.9%, 11.5%, 6.0%, 5.5%, 5.1%, and 4.7% of the total recorded species, respectively. The dominant genus observed was *Artemisia* (8) (Table 1).

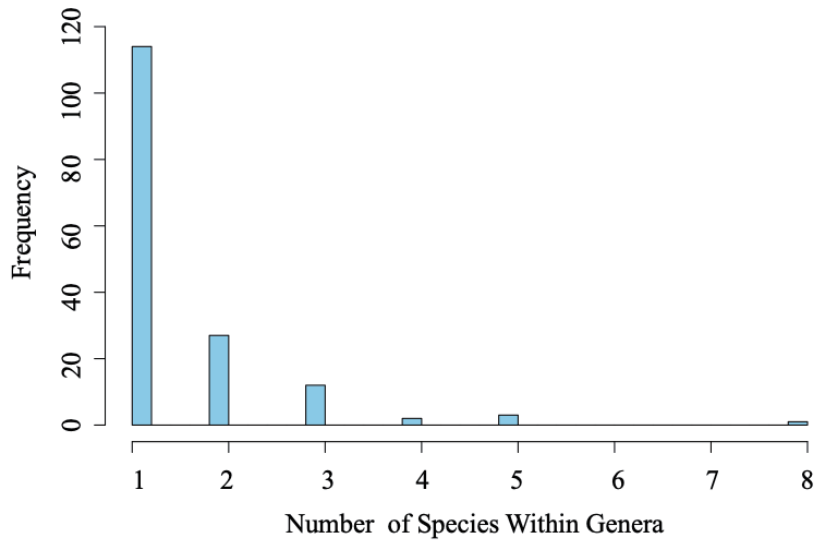


Fig. 2 Species in different genera of plants in Balluk Mountain

Table 1 Major medicinal plant families and genera in Balluk Mountain

Composition	59 families 159 genera 235 species
Main families (No. species)	<i>Asteraceae</i> (35) <i>Rosaceae</i> (27) <i>Lamiaceae</i> (14) <i>Umbelliferae</i> (13) <i>Ranunculaceae</i> (12) <i>Caryophyllaceae</i> (11)
Main genera (No. species)	<i>Artemisia</i> (8)

3.3 Specific and endangered medical plants in Xinjiang

There are numerous species of endangered, unique, and rare plants in Xinjiang. One such example is *Ferula*, an endangered medicinal plant. It thrives in the cold and arid gray-calcium desert soil at an altitude of 750-1000 m. The plant reaches a height of 50-100 cm, with erect stems covered with white hairs. Its roots are large, cylindrical or spindle-shaped, and sometimes branched. The skin of the plant is purple-black and emits an unpleasant odor. Asafoetida

(*Ferula*) possesses a pungent aroma and exhibits various medicinal properties. It is known to regulate qi, reduce swelling, promote blood circulation, eliminate fatigue, dissolve phlegm, and stimulate nerves. It is highly regarded for its effectiveness in treating conditions such as rheumatoid arthritis and stomach problems. Additionally, some pharmacopoeias recommend its use for expelling worms and treating vitiligo. The medicinal parts of *Ferula* are primarily the rhizomes and seeds, with ferulic acid being the active ingredient.

During the national survey of Chinese



herbal medicines, more than 20 species of *Ferula* were discovered in Xinjiang. However, only two species, *Ferulicum ferulae* (*F. sin-kiangensis*) and *Ferulicum ferulae* (*F. fukanensis*), are included in the Pharmacopoeia for medicinal use. Unfortunately, due to severe damage, Fukang *Ferula* is now extinct. The wild Xinjiang *Ferula* is only distributed in Baishidun Mountain, Kashi Township, Yining County, Yili. In the “Regulations on the Protection and Management of Wild Medicinal Resources,” Xinjiang *Ferula* is listed as an important wild medicinal species under

secondary protection [7].

3.4 Therapeutic effects of endangered medicinal plants in Xinjiang

In our research, we collected five different species of rare medicinal plants in Balluk Mountain, namely Tianshan Cherry, Xinjiang Wild Apple, Wild Almond, Root Peony, and *Ferulae* (Table 2). The respective families, genera and species of these plants are listed below in Table 2.

Table 2 Endangered medicine plants in Balluk Mountain

Families	Genera	Species	Latin name	Medicinal value
Rosaceae	Cherry	Tianshan wild cherry	<i>Cerasus tianschanica</i> Pojark.	Clearing the lungs, relieving the throat, and relieving cough [8]
Rosaceae	Malus	Xinjiang wild apple	<i>Malus sieversii</i> (Ldb.) M.Roem.	/
Rosaceae	Amygdalus	Wild Almond	<i>Amygdalus Ledebouriana</i> Schleche.	Heart health, obesity-related diseases and various cancers [9]
Paoniaceae	Paoniaceae	root peony	<i>Paeonia anomala</i> L.	Clearing heat, activating blood circulation, removing blood stasis, etc [10]
Umbelliferae	Ferula	Asafoetida	<i>Ferula</i> L.sp	Regulateing qi and reducing swelling, activating blood and eliminating fatigue, eliminating phlegm and exciting nerves [7]

The medicinal plants and their value are as follows:

(1) Tianshan Cherry is believed to have antioxidant and anti-inflammatory effects. Tianshan Cherry is used to promote digestion, relieve cough and asthma, and improve kidney function. It is also considered beneficial for the skin and is used in skincare formulations.

(2) Xinjiang Wild Apple is known for its high levels of antioxidants and flavonoids. It is believed to have anti-inflammatory, antibacterial, and antiviral properties. Xinjiang Wild Apple is used in traditional medicine for its potential to boost the immune

system, support cardiovascular health, and improve digestion. It is also used in cosmetic formulations due to its beneficial effects on the skin.

(3) Wild Almond is valued for its medicinal properties. It is rich in nutrients, including healthy fats, vitamins, and minerals. Wild Almond is known for its potential to support brain health, improve heart health, regulate blood sugar levels, and enhance digestion.

(4) Root Peony also has a long history of use in traditional Chinese medicine. Its roots, known as *Radix Paeoniae*, are highly valued for their medicinal properties. Root Peony is used to



alleviate pain and inflammation, regulate menstrual cycles, and treat gynecological disorders. It is also believed to have antioxidant and immune-enhancing effects.

(5) Ferulae are used in traditional medicine

for their expectorant, digestive, and antispasmodic effects. They are believed to aid in respiratory conditions, digestive disorders, and joint pain.

Detailed information on all the collected plants are shown in Table 3.

Table 3 Statistics of medicine resources in Balluk Mountain

No.	Families	Genera	Species	Latin
1	Asteraceae	Lithocarpus	Lithocarpus	<i>Ancathia igniaria</i> (Spreng.)DC.
2	Amaranthaceae	Amaranthaceae	wild amaranth	Herba seu Radix Amaranthi
3	Liliaceae	Trinidad	Heteroptera	<i>Eremurus anisopterus</i> (Kar.et Kir)Rgl.
4	Cypress	Juniper	Siberian Juniper	<i>Janiperus sibirica</i> Burgsd.
5	Cypress	Juniper	Cypress xinjiang	<i>Juniperus pseudosabina</i> Fisch.et Mey.
6	Cypress	Juniper	Eurasian juniper	<i>Juniperus sabina</i> L.
7	Patellaceae	Valerian	Valerian	<i>Valeriana officinalis</i> L.
8	Primulaceae	Prunus	North spot plum	<i>Androsace septentrionalis</i> L.
9	Primulaceae	Primulaceae	macrocalyx	<i>Primula macrocalyx</i> Bge.
10	psyllium	psyllium	plate psyllium	<i>Plantago depressa</i> Willd.
11	Tamarixaceae	Cypress	beautiful water cypress branch	<i>Myricaria pulcherrima</i> Batal.
12	Dipsacus	Bluebones	yellow potted flower	<i>Scabiosa ochroleuca</i> L.
13	Lamiaceae	Nepeta	Alpine Nepeta	<i>Nepeta mariae</i> Pojark.
14	Lamiaceae	Phyllostachys	grassland Phyllostachys	<i>Phlomis pratensis</i> kar.et Kir.
15	Lamiaceae	Scutellaria	Scutellaria	<i>Scutellaria baicalensis</i> Georgi.
16	Lamiaceae	Cerium	Whole leaf green orchid	<i>Dracocephalum integrifolium</i> Bge.
17	Lamiaceae	Sesame	Sesame	<i>Lamium album</i> L.
18	Lamiaceae	Oregano	Oregano	<i>Origanum vulgare</i> L.
19	Lamiaceae	Scutellaria	helmeted skullcap	<i>Scutellaria galericulata</i> L.
20	Lamiaceae	Xintahua	Aromatic new tower flower	<i>Ziziphora clinopodioides</i> Lam.
21	Lamiaceae	Motherwort	xinjiang Motherwort	<i>Leonurus turkestanicus</i> V.Krecz.et Kupr.
22	Lamiaceae	Phyllostachys	Phalaenopsis	<i>Phlomis tuberosa</i> L.
23	Lamiaceae	Salvia	xinjiang Salvia	<i>Salvia deserta</i> Schang.
24	Lamiaceae	Thyme	Exotic Thyme	<i>Thymus marschallianus</i> Willd.
25	Lamiaceae	Ageratum	Twisted Ageratum	<i>Lophanthus chinensis</i> Benth.
26	Lamiaceae	Nepeta	recumbent nepeta	<i>Nepeta supina</i> Srev.
27	Euphorbiaceae	Euphorbiaceae	thick-rooted euphorbia	<i>Euphorbia macrorrhiza</i> C.A.M.ex Ldb.

(to be continued)



Continued table 3

No.	Families	Genera	Species	Latin
28	thick-rooted euphorbia	thick-rooted euphorbia	hops	<i>Humulus lupulus</i> L.
29	Papilionaceae	Melilotus	Sweet clover	<i>Melilotus officinalis</i> (L.)Desr.
30	Fabaceae	Vetum	Tianshan vetch	<i>Vicia semenovii</i> (Regel et Herd.) B. Fedtsch.
31	Fabaceae	Astragalus	Astragalus	<i>Astragalus penduliflorus</i> Lam.
32	Fabaceae	Donkey Bean	red bean grass	<i>Onobrychis lutues</i>
33	Fabaceae	A pea	A pea	<i>Orobus luteus</i> L.
34	Fabaceae	Vetum	Stem Vet	<i>Vicia multicaulis</i> Ldb.
35	Fabaceae	Oxytropis	Oxytropis	<i>Oxytropis recognita</i> Bge.
36	Impatiens	Impatiens	Impatiens	<i>Impatiens balsamina</i> L.
37	Poaceae	Brome	Bromus inermis	<i>Bromus inermis</i> Leyss.
38	Poaceae	genus Timothy genus	read aloud	<i>Phleum pratense</i> L.
39	Poaceae	Lysium	Leymus secalinus	<i>Leymus secalinus</i> (Georgi)Tzvel.
40	Saxifragaceae	Prunus	Two-leaf plum grass	<i>Parnassia bifolia</i> Nekras.
41	Saxifragaceae	Saxifraga	Surplus Saxifrage	<i>Saxifraga cernua</i> L.
42	Saxifragaceae	Saxifragaceae	bulbous saxifrage	<i>Saxifraga sibirica</i> L.
43	Saxifragaceae	Golden Waist	bare stem golden waist	<i>Veronica longifolia</i> L.
44	Saxifragaceae	Prunus	Green Leaf Plum Grass	<i>Parnassia viridiflora</i> Batal.
45	Saxifragaceae	Currant	black currant	<i>Ribes nigrum</i> L.
46	Anthraceae	Anthraceae	Anthraceae	<i>Polemonium coeruleum</i> L.
47	Birchaceae	Birchaceae	Verrucous birch	<i>Betula pendula</i> Roth.
48	False Primula	Pseudoprimula	false primrose	<i>Cortusa brotheri</i> Pax.ex Lipsky
49	Violaceae	Violaceae	Tianshan Viola	<i>Viola tianschanica</i> Maxim.
50	Malvaceae	Hollyhock	Hollyhock	<i>Althaea rosea</i> (L.)Cav.
51	Malvaceae	Malvaceae	mallow	<i>Malvaceae verticillata</i> L.
52	Crassulaceae	Crassulaceae	Sedum broadleaf	<i>Sedum ellacombianum</i> Praeger
53	Crassulaceae	Crassulaceae	hybrid sedum	<i>Sedum hybridum</i> L.
54	Crassulaceae	Crassulaceae	Sedum notoginseng Sedum notoginseng	<i>Sedum aizoon</i> L.
55	Crassulaceae	Valencia	Valencia longifolium	<i>Rosularia alpestris</i> (Kar.et kir)Aibor.
56	Crassulaceae	Rhodiola	Rhodiola rhodiola	<i>Rhodiola rosea</i> L.
57	Campanulaceae	Campanula	bellflower	<i>Campanula glomerata</i> L.

(to be continued)



Continued table 3

No.	Families	Genera	Species	Latin
58	Campanulaceae	Codonopsis	Xinjiang Codonopsis	<i>Codonopsis clematidea</i> (Schrenk)Clarke.
59	Asteraceae	Achilles	Chiba	<i>Achillea millefolium</i> Linn.
60	Asteraceae	Panax	Return sun ginseng	<i>Crepis rigescens</i> Diels
61	Asteraceae	Phyllostachys	flying canopy	<i>Erigeron acer</i> L.
62	Asteraceae	Cosmos	Tingling chrysanthemum	<i>Jurinea scapiformis</i> Shih.
63	Asteraceae	Dandelion	chrysanthemum	<i>Taraxacum mongolicum</i> Hand.-Mazz.
64	Asteraceae	Rockwort	Tianshan rock lettuce	<i>Cicerbita azurea</i> (Ldb.)Beauv.
65	Asteraceae	Panax	Mao Huan Yang Ginseng	<i>Crepis polytricha</i> (Tdb.)Turcz.
66	Asteraceae	Artemisia	Artemisia xinjiang	<i>Hippolytia herderi</i> Poljak.
67	Asteraceae	Ligularia	Mountain Ligo	<i>Ligularia narynensis</i>
68	Asteraceae	Psyllium	psyllium	<i>Pulicaria prostrata</i> (Gilb.)Aschers.
69	Asteraceae	Senecio	Brassica japonica Senecio	<i>Senecio erucifolus</i> L.
70	Asteraceae	Twisthead	Pseudo-mud hulai	<i>Serratula coronata</i> L.
71	Asteraceae	Twisthead	Stemless Twist Heads	<i>Serratula lyratifolia</i> Schrenk.
72	Asteraceae	Artemisia	Artemisia chrysanthemum	<i>Tanacetum crassipes</i> (Stschgel.) Tzvel.
73	Asteraceae	Salsify	Prairie Salsify	<i>Tragopogon pratensis</i> L.
74	Asteraceae	Coltsfoot	coltsfoot	<i>Tussilago farfara</i> L.
75	Asteraceae	Aster	alpine aster	<i>Aster alpinus</i> L.
76	Asteraceae	Centaurea	Eurasian cornflower	<i>Centaurea ruthenica</i> Lam.
77	Asteraceae	Mountain willow	Mountain willow chrysanthemum	<i>Hieracium umbellatum</i> L.
78	Asteraceae	Edelweiss	gray-yellow edelweiss	<i>Leontopodium Ochroleucum</i> Beauv.
79	Asteraceae	Zebrasia	beautiful chrysanthemum	<i>Saussurea blanda</i> Schrenk.
80	Asteraceae	Artemisia	tarragon	<i>Artemisia dracunculus</i> L.
81	Asteraceae	Liquor	small white wine grass	<i>Conyza canadensis</i> (L.)Cronq.
82	Asteraceae	Cyanocephalus	Tianshan blue thorn head	<i>Echinops tianshanicus</i> Bobr.
83	Asteraceae	Lactuca	wild lettuce	<i>Lactuca sativa</i> L.
84	Asteraceae	Arctium	mountain burdock	<i>Arctium tomentosum</i> Mill.
85	Asteraceae	Artemisia	Cold Artemisia	<i>Artemisia frigida</i> Willd.
86	Asteraceae	Inula	Inulin	<i>Inula helenium</i> L.
87	Asteraceae	Inula	sheep's eye	<i>Inula rhizocephala</i> Schrenk.
88	Asteraceae	Artemisia	wild mugwort	<i>Artemisia lavandulaefolia</i> DC.

(to be continued)



Continued table 3

No.	Families	Genera	Species	Latin
89	Asteraceae	Cucus	Suju	<i>Filago arvensis</i> L.
90	Asteraceae	Milk aster	milk aster	<i>Galatella punctata</i> (W.et K.) Nees.
91	Asteraceae	Inula	Inula	<i>Inula britannica</i> L.
92	Asteraceae	Zebrasia	Tianshan snow lotus	<i>Saussurea involucrata</i> (Kar. et Kir.) Sch.-Bip.
93	Chrysanthemum	cold fern	cold fern	<i>Cystopteris fragilis</i> (L.) Bernh.
94	koranko	Spotted Orchid	small variegated orchid	<i>Goodyera repens</i> (L.) R.Br.
95	koranko	Panax	Ginseng	<i>Gymnadenia conopsea</i> (L.) R.Br.
96	Chenopodiaceae	Chenopodiaceae	Gray quinoa	<i>Chenopodium glaucum</i> L.
97	Chenopodiaceae	Chenopodiaceae	Quinoa	<i>Chenopodium bortrys</i> L.
98	Chenopodiaceae	Aquinas	Aquinas	<i>Altriplex patens</i> (Litv.) Iljin.
99	Polygonaceae	Polygonaceae	Alpine Polygonum	<i>Polygonum alpinum</i> All.
100	Polygonaceae	Polygonaceae	save	<i>Polygonum aviculare</i> L.
101	Polygonaceae	Polygonaceae	Polygonum fistula (Polygonum polygonum)	<i>Rubia yunnanensis</i> (Franch. ex Diels) Diels
102	Polygonaceae	Polygonaceae	Polygonum curcuma	<i>Polygonum convolvulus</i> L.
103	Polygonaceae	Polygonaceae	Polygonum peach leaf	<i>Polygonum persicaria</i> L.
104	Polygonaceae	sorrel	Crumpled sorrel	<i>Rumex crispus</i> L.
105	Polygonaceae	sorrel	Sorrel	<i>Rumex pseudonatronatus</i> Borb.
106	Lepidopteridaceae	Lepidopteris	European Lepidopteris	<i>Dryopteris filix-max</i> (L.) Schott.
107	Willowleafaceae	Willow	small flower willow leaf	<i>Epilobium parviflorum</i> Schreb.
108	Willowleafaceae	Willow	marsh green willow	<i>Epilobium palustre</i> L.
109	Willowleafaceae	Willow orchid	willow orchid	<i>Chamaenerion angustifolium</i> (L.) Scop.
110	Gentianaceae	Gentianaceae	Gentiana chinensis	<i>Gentiana tianschanica</i> Rupr.
111	Gentianaceae	Pleurotus	flat bud	<i>Gentianopsis barbata</i> (Froel.) Ma.
112	Wintergreenaceae	dahlias	Daffodil	<i>Moneses uniflora</i> (L.) A.Cray.
113	Wintergreenaceae	Unilateral	Unilateral flower	<i>Ramischia secunda</i> Garcke.
114	Ephedraceae	Ephedraceae	Single Ephedra	<i>Ephedra mohnosperma</i> Gmel ex C. A. Meyer.
115	Ephedraceae	Ephedraceae	Chinese ephedra	<i>Ephedra intermedia</i> Schrenk.
116	Bragoniaceae	Geranium	Prairie geranium	<i>Geranium pratense</i> L.
117	Bragoniaceae	Geranium	Geranium roundleaf	<i>Geranium rotundifolium</i> L.
118	Bragoniaceae	Geranium	blue geranium	<i>Geraniaceae pseudosibiricum</i> J.Mayer.

(to be continued)



Continued table 3

No.	Families	Genera	Species	Latin
119	Bragoniaceae	Bragoniaceae	Bragoniaceae	<i>Erodium stephanianum</i> Willd.
120	Ranunculaceae	Aconitum	diphtheria aconitum	<i>Aconitum leucostomum</i> Worosch.
121	Ranunculaceae	Clematis	siberian clematis	<i>Clematis sibirica</i> Mill.
122	Ranunculaceae	Aconitum	woodland aconitum	<i>Gypsophila paniculata</i> L.
123	Ranunculaceae	Tang sedge	Fragrant pine grass	<i>Thalictrum foetidum</i> L.
124	Ranunculaceae	Anemone	large flower anemone	<i>Anemone silvestris</i> L.
125	Ranunculaceae	Aquilegia	Purple columbine	<i>Aquilegia viridiflora</i> Pall. form. <i>atropurpurea</i>
126	Ranunculaceae	Pulsatilla	Mongolian Pulsatilla	<i>Pulsatilla ambigua</i> Turcz.
127	Ranunculaceae	Tang sedge	Alpine pine grass	<i>Thalictrum alpinum</i> L.
128	Ranunculaceae	Clematis	Oriental Clematis	<i>Clematis orientalis</i> L.
129	Ranunculaceae	Ranunculus	buttercup	<i>Ranunculus japonicus</i> Thunb
130	Ranunculaceae	Ranunculus	Shi Longrui	<i>Ranunculus sceleratus</i> L.
131	Ranunculaceae	Tang sedge	Yellow pine grass	<i>Thalictrum flavum</i> L.
132	Oleaceae	Ash	Ash tree	<i>Fraxinus chinensis</i> Roxb.
133	Oleaceae	Ash	Small Leaf Ash Tree	<i>Fraxinus sogdiana</i> Bge.
134	Equisetaceae	Equisetum	ask thorns	<i>Equisetum arvense</i> L.
135	Equisetaceae	Equisetum	Horsetail	<i>Equisetum hyemale</i> L.
136	Rubiaceae	Lara vine	Potatoes	<i>Galium verum</i> L.
137	Rubiaceae	Lara vine	northern lala vine	<i>Galium boreale</i> L.
138	Rosaceae	Collales	Altai Collardgrass	<i>Alchemilla pinguis</i> Juz.
139	Rosaceae	Potentia	Wilhelm biflora	<i>Potentilla biflora</i> Willd.ex Schlecht.
140	Rosaceae	Potentia	Wilhelm bifida	<i>Potentilla bifurca</i> L.
141	Rosaceae	Cotoneaster	Cotoneaster shaohuazi	<i>Cotoneaster oliganthus</i> Pojark.
142	Rosaceae	Salicylum	Water bayberry	<i>Geum aleppicum</i> Jacq.
143	Rosaceae	Rosa	ground rose	<i>Chamaerhodos erecta</i> (L.)Bge.
144	Rosaceae	Cherry	Tianshan wild cherry	<i>Cerasus tianschanica</i> Pojark.
145	Rosaceae	Hawthorn	Junggar Hawthorn	<i>Grataegus songorica</i> K.Koch.
146	Rosaceae	Rosa	Rosa denticula	<i>Rosa albertii</i> Regel
147	Rosaceae	Rosa	rosebush	<i>Rosa laxa</i> Retz
148	Rosaceae	Rosa	multiflora rose	<i>Rose muitiflora</i> Thunb.
149	Rosaceae	Rosa	prickly rose	<i>Rose spinosissima</i> L.

(to be continued)



Continued table 3

No.	Families	Genera	Species	Latin
150	Rosaceae	Rubus	Rubus shisheng	<i>Rubus saxatilis</i> L.
151	Rosaceae	Spiraea	Spiraea trilobata	<i>Spiraea trilobata</i> L.
152	Rosaceae	Agaria	Agrimony	<i>Agrimonia pilosa</i> Ldb.
153	Rosaceae	Amygdalus	Wild Almond	<i>Amygdalus Ledebouriana</i> Schleche.
154	Rosaceae	Malus	Xinjiang wild apple	<i>Malus sieversii</i> (Ldb.)M.Roem.
155	Rosaceae	Piperia	Snake with Potentilla	<i>Potentilla kleimiana</i>
156	Rosaceae	Cotoneaster	Cotoneaster multiflower	<i>Cotoneaster multiflorus</i> Bge.
157	Rosaceae	Fragaria	forest strawberry	<i>Fragaria vesca</i> L.
158	Rosaceae	Piperia	Asian wilt	<i>Potentilla asiatica</i> Juz.
159	Rosaceae	Piperia	Prairie wilt	<i>Potentilla desertorum</i> Bge.
160	Rosaceae	Rubus	Sakhalin Rubus	<i>Rubus sachalinensis</i> Levl.
161	Rosaceae	Burnet	Burnet	<i>Sanguisorba officinalis</i> L.
162	Rosaceae	Sorbus	Sorbus tianshan	<i>Sorbus tianschanica</i> Rupr.
163	Rosaceae	Spiraea	Bigleaf Spiraea	<i>Spiraea chamaedryfolia</i> L.
164	Rosaceae	Spiraea	Spiraea tianshanensis	<i>Spiraea tianschanica</i> Pojark.
165	Solanaceae	Hymenia	fairy	<i>Hyoscyamus niger</i> L.
166	Solanaceae	Solanaceae	Solanum nigrum	<i>Solanum nigrum</i> L.
167	Solanaceae	Solanaceae	Solanum nigrum	<i>Solanum alatum</i> Moench.
168	Solanaceae	Solanaceae	Red nightshade	<i>Solanum alatum</i> Moench.
169	Solanaceae	Solanaceae	Red eggplant	<i>Solanum verbascifolium</i>
170	Ginseng	Ginseng	Ginseng	<i>Polygonum bistorta</i> L.
171	Honeysuckle	Honeysuckle	bristly honeysuckle	<i>Lonicera hispida</i> Pall. ex Roem. et Schult.
172	Honeysuckle	Honeysuckle	Honeysuckle Tartar	<i>Salvia deserta</i> Schang.
173	Honeysuckle	Honeysuckle	Honeysuckle Honeysuckle	<i>Lonicera microphylla</i> Willd.
174	Umbelliferae	Ceratia	alpine fescue	<i>Aegopodium alpestre</i> Ldb.
175	Umbelliferae	Ceratia	Feta	<i>Aegopodium podagraria</i> L.
176	Umbelliferae	Bupleurum	Chuanzebupleurum	<i>Bupleurum aureum</i> Fisch.
177	Umbelliferae	Bupleurum	Tianshan Bupleurum	<i>Bupleurum tianschanicum</i> Freyn.
178	Umbelliferae	Rockwind	rock wind	<i>Libanotis buchtormensis</i>
179	Umbelliferae	Sulphur	White flower sulchin	<i>Schultzia albiflora</i> M.Pop.
180	Umbelliferae	Artemisia	Artemisia spp.	<i>Seseli glabratum</i> Willd.ex Schult.

(to be continued)



Continued table 3

No.	Families	Genera	Species	Latin
181	Umbelliferae	Ferula	Asafoetida	<i>Ferula</i> L.sp
182	Umbelliferae	Glycyrrhizae	Geshanxiang	<i>Ostericum citriodorum</i> (Hance) Yuan.et Shan
183	Umbelliferae	Peaches	yellow pedicure	<i>Peucedanum morisonii</i> Bess.
184	Umbelliferae	Broadband	Trichocarp	<i>Platytaenia dasycarpa</i> (rgl.et Schmalh.) Korov.
185	Umbelliferae	Broadband	celery	<i>Platytaenia rubtzovii</i> Schischk.
186	Umbelliferae	Artemisia	Artemisia waiyili	<i>Seseli tschuiiense</i> N.Pavl.
187	Paeoniaceae	Paeoniaceae	root peony	<i>Paeonia anomala</i> L.
188	Paeoniaceae	Paeoniaceae	narrow leaf peony	<i>Paeonia hybrida</i> Pall.
189	Cruciferae	Camelina	shepherd's purse	<i>Capsella bursa-pastois</i> (L.)Medic.
190	Cruciferae	Tingli	Tingli	<i>Draba nemorosa</i> L.
191	Cruciferae	Saccharomyces	Altai sugar chestnut	<i>Erysimum altaicum</i> C.A.M.
192	Cruciferae	gaga	Curd cabbage	<i>Thlaspi arvense</i> L.
193	Cruciferae	Garlic mustard	Garlic mustard	<i>Sisymbrium altissimum</i> L.
194	Cruciferae	Myrina	Minced rice chestnuts	<i>Cardamine parviflora</i> L.
195	Caryophyllaceae	Perilla	Tianshan roll ear	<i>Cerastium tianschanicum</i> Schischk.
196	Caryophyllaceae	Muscarina	Muscaria muscaria	<i>Silene holopetala</i> Bge.
197	Caryophyllaceae	Perilla	field ear	<i>Cerastium arvense</i> L.
198	Caryophyllaceae	Caryophyllaceae	Dianthus longifolia	<i>Dianthus kuschakewiczii</i> Ggl.et Schmalh.
199	Caryophyllaceae	Muscarina	Medium-sized Muscarina	<i>Silene media</i> Klerp.
200	Caryophyllaceae	Muscarina	Junggar Flygrass	<i>Silene songarica</i>
201	Caryophyllaceae	stone flower	cone stone flower	<i>Aconitum nemorum</i> M.pop.
202	Caryophyllaceae	stone flower	Purple calyx stone flower	<i>Gypsophila patrinii</i> Ser.
203	Caryophyllaceae	Perilla	diqi roll ear	<i>Cerastium dichotomum</i> L.
204	Caryophyllaceae	Muscarina	Muscaria densiflora	<i>Silene densiflora</i> D`Urv.
205	Caryophyllaceae	Chickweed	chickweed	<i>Stellaria brachypetala</i> Bge.
206	Water keel	Water Keel	Eurasian water keel	<i>Polypodium vulgare</i> L.
207	Pine Branch	Spruce	Snow Ridge Spruce	<i>P.schrenkiana</i> Fischet Mey_
208	Garciniaceae	Hypericum	Hypericum	<i>Hypericum elongatum</i> Ldb.
209	Garciniaceae	Hypericum	Hypericum	<i>Hypericum hirsutum</i> L.
210	Asplenidae	Asplenidae	Asplenium forkleaf	<i>Asplenium septentrionale</i> (L.)Hoffm.

(to be continued)



No.	Families	Genera	Species	Latin
211	Berberidaceae	Berberidaceae	Siberian barberry	<i>Berberis sibirica</i> Pall.
212	Scrophulariaceae	Artemisia	Broken Rice Fern Leaf Artemisia	<i>Pedicularis cheilanthifolia</i> Schrenk.
213	Scrophulariaceae	Mother-in-law	Granny Suoka	<i>Veronica spicata</i> L.
214	Scrophulariaceae	Eyebright	Eyebright	<i>Euphrasia peetinata</i> Ten.
215	Scrophulariaceae	Mullein	Mullein	<i>Verbascum thapsus</i> L.
216	Scrophulariaceae	Wild flax	wild flax	<i>Dodartia orientalis</i> L.
217	Scrophulariaceae	Mother-in-law	Strawberry	<i>Veronica beccabunga</i> L.
218	Scrophulariaceae	Mother-in-law	Rabbit tail seedlings	<i>Veronica longifolia</i> L.
219	Scrophulariaceae	Mother-in-law	Long fruit water bitter	<i>Veronica anagalloides</i> Guss.
220	Scrophulariaceae	Mother-in-law	Mihua Pona	<i>Veronica densiflora</i> Ldb.
221	Convolvulaceae	Convolvulaceae	field bindweed	<i>Convolvulus arvensis</i> L.
222	Convolvulaceae	Cuscuta	Cuscuta	<i>Cuscuta chinensis</i> Lam.
223	Urticaceae	Urticaceae	highland nettle	<i>Urtica hyperborea</i> Jacp.ex Wedd.
224	Urticaceae	Urticaceae	broadleaf nettle	<i>Urtica laetevirens</i> Maxim.
225	Poppyaceae	Poppyaceae	wild poppy	<i>Papaver nudicaule</i> L.
226	Poppyaceae	Celandine	Celandine	<i>Chelidonium majus</i> L.
227	Iridaceae	Iridaceae	Iris membranaceus	<i>Iris scariosa</i> Willd.ex Link.
228	Polygalaceae	Polygalaceae	xinjiang Polygalaceae	<i>Polygala hybrida</i> DC.
229	Rutaceae	Rutaceae	Phytophthora xinjiang	<i>Dictamnus angustifolius</i> G.Don ex Sweet.
230	Boraginaceae	Glaucoma	Inverted jug	<i>Cynoglossum amabile</i> Stapf et Drumm.
231	Boraginaceae	Crane Lice	crane lice	<i>Lappula myosotis</i> Moench.
232	Boraginaceae	Forget-me-not	grassland forget-me-not	<i>Myosotis suaveolens</i> W.et K.
233	Boraginaceae	Neophyllum	new wind wheel	<i>Calamintha debilis</i> (Bge) Benth.
234	Boraginaceae	Glaucoma	Little flower glass grass	<i>Cynoglossum lanceolatum</i> Forsk.
235	Boraginaceae	Forget-me-not	Myosotis sylvatica	<i>Myosotis sylvatica</i> Hoffm.

4 Discussion

Balluk Mountain National Nature Reserve, located between the Tianshan Mountains and the Altai Mountains in Xinjiang Province, is a first-level forest reserve with a wealth of valuable medicinal plants. Our research in the area yielded the collection

of 235 species of medicinal plants, belonging to 59 families and 159 genera. Among them, six families, namely *Asteraceae*, *Caryophyllaceae*, *Lamiaceae*, *Ranunculaceae*, *Rosaceae* and *Umbelliferae*, exhibited high species diversity, with 35, 11, 14, 12, 27, and 13 species respectively. These families' dominant roles may be attributed to their superior



reproductive structures and strong environmental adaptability. However, further research is required to explore this aspect in more detail.

Several species in Balluk Mountain possess significant value due to their medicinal properties and potential contributions to various research fields. In this survey, we identified notable species that show promise for natural product chemistry and drug development. For example, Tianshan Cherry warrants further exploration and purification of its effective components due to its antioxidant, anti-inflammatory effects, and potential benefits for skincare. Xinjiang Wild Apple shows potential for enhancing the immune system, supporting cardiovascular health, and improving digestion, making it a significant candidate for drug development and natural product research. In addition to their medicinal value, the findings of this survey have implications for other research areas. The abundant plant resources in Balluk Mountain present opportunities for natural product chemistry, enabling researchers to isolate and study bioactive compounds with potential pharmaceutical applications. These plants are valuable sources of novel chemical compounds for drug discovery and development.

Meanwhile, despite the abundance of plant resources in Balluk Mountain, the development, utilization, and protection of these resources are currently inadequate. Many endangered species have not received sufficient attention, and protected reserve areas have not been established for certain plants like wild almonds. Additionally, excessive acquisition and utilization by humans have led to increased degradation of grasslands, rendering the ecosystem increasingly fragile. Updating the plant resources in Balluk Mountain is therefore crucial for preserving and promoting the diversity of the region, particularly for endangered plants that have gone unnoticed. It is necessary to strike a balance between development and utilization of plant resources while

ensuring their protection.

In order to solve these problems, the following suggestions are made. Firstly, scientific research on the plant resources of Balluk Mountain should be strengthened. This can be achieved by increasing research funding, enhancing local collaboration, conducting extensive basic research on plants in Xinjiang, and conducting comprehensive evaluations of the development and utilization potential of plant resources. Secondly, protection of endangered plants should be enhanced. This involves implementing centralized management of degraded grasslands using ecological restoration techniques, adopting responsible herb collection practices, raising public awareness of ecological protection, and imposing strict penalties on poachers.

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