

# Wild Himalayan fruits of Indian range: Health benefits, applications, and strategies to overcome conservation and harvesting challenges

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## Introduction

The Indian Himalayan range is divided in four major regions from west to east. The north-west Himalayan range lies in the states of Uttarakhand, Himachal Pradesh and Jammu & Kashmir; the eastern and northeastern Himalayan region, covers Darjeeling, Arunachal Pradesh, and Sikkim; and the eastern Himalayas consists of the states of Mizoram, Nagaland, Assam, Tripura, Manipur, and Meghalaya (Lata et al., 2023). The Himalayas hosts the world's largest agro-ecosystem and the most significant crop biodiversity. The status of India as a “mega-biodiversity” nation is mostly due to the Himalayas as they are regarded as a global biodiversity “hotspot” and niche to 2532 species of the 6000 native species that are found worldwide (Rao & Pant, 2001). The Himalayan region is linked to more than 675 species of edible wild plants, making it one of the richest biodiversity locations. These are proven to help indigenous communities satisfy their economical and nutritional needs (Bhatt et al. 2017; Semwal et al. 2022). Fruit is a vital component of human nutrition since it includes many antioxidants and phytochemicals (Fatima et al., 2025). Edible wild fruits are regarded as nutrient-dense because of their varied genotypes, environmental factors, and high phytochemical content of therapeutic compounds like flavonoids and anthocyanins. Despite their potential advantages, these fruits are usually overlooked and neglected. Recently, a few wild fruits have been focused for the development base in pharmaceutical industries, the majority of which are considered safe to eat (Brandi et al. 2006).

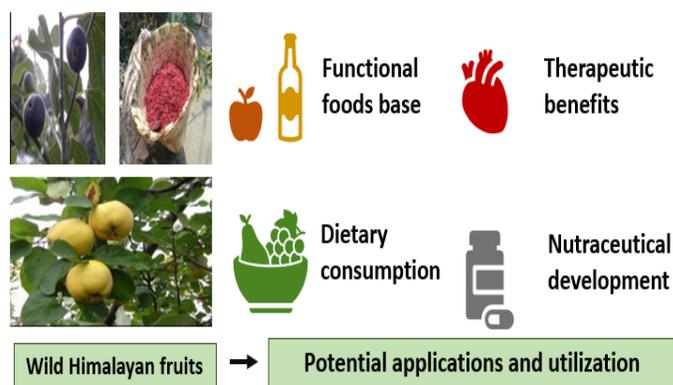
## Health benefits of wild Himalayan fruits

Wild edible fruits contain biologically active ingredients, like phytochemicals in considerable amounts besides its nutritional value. Eating wild fruits has been linked in numerous epidemiological studies to several health benefits, that include lowering the risk of heart disease, high blood pressure, cancer, diabetes, obesity, gastrointestinal problems, and degenerative/ age-related disorders (Angami et al. 2024; Gangapriya et al. 2022). A number of social, spiritual, and cultural facets of human existence are intimately linked to the use of edible fruits as food and medicine. Particularly in the Himalayan region, there are different kinds of food and medicinal plant species that have a potential to provide both nutritional and medicinal benefits and are easily available, tasty, and reasonably priced (Fatima et al., 2025). Some of the examples of these fruits are sea buckthorn, bayberry, crab apple, hisalu, bedu, and wild apricot.

**Potential applications of wild Himalayan fruits:** The eastern Himalayan region provides a vast amount of room

supporting establishment and evolution of various wild edible species. The hill people of this area alone eat over 300 of the 800 types of edible wild tree species found in India. As a result, the area is regarded as an origin of many crop species, including their wild relatives, that are grown naturally in the indigenous tribe backyards and forests. In addition to being consumed locally, the fruits that are gathered from the forest and their own property are also sold for a premium price in the local market (Figure 1). Self-help groups (SHGs) and business owners produce and sell a number of value-added goods made from these wild fruits, including wine, vinegar, jam, jelly squash, ready-to-serve beverages, pickles, etc. But because of poor commercial production their availability is still lacking (Rymbai et al., 2023).

People from the Northwestern Himalayas possess an extensive record understanding the benefits of food processing and preservation and their therapeutic effects. Prebiotics, polyphenols, antioxidants, and additional bioactive compounds are examples of functional elements found in foods from the northwest Himalayan region. These useful substances support immune system modulation, blood glucose regulation, and weight management (Harasym et al., 2020). Traditional food of these regions has a great deal of potential to reduce the likelihood of lifestyle problems like diabetes, obesity, and heart-related conditions. (Ojha et al.,



2022)

**Fig. 1. Utilization of wild Himalayan fruits for food industries, nutraceuticals development, and health benefits**

## Challenges in Conservation and Harvesting of Himalayan Fruits

Many valuable species face threats from habitat fragmentation, overharvesting, and lack of awareness about sustainable harvesting practices. These issues are compounded by climate change, which stresses fragile mountain

ecosystems, leading to biodiversity loss and reduced regeneration capacity of fruit-bearing plants like *Malus spp.* and *Rubus spp.* (Rana et al. 2022). The need for food and feed for both human and livestock population is driving up carbon emissions and energy consumption in agricultural systems. This includes substantial application of pesticides, fertilizers, energy, farm equipment driven by fossil fuels, and other inputs (Ritika et al., 2024).

### Overharvesting and habitat loss

The increasing demand for wild Himalayan fruits, driven by commercial interests and local consumption, has led to concerns about overharvesting. Unsustainable harvesting practices, such as damaging plants or collecting immature fruits, can deplete natural populations and affect regeneration (Shrestha & Dhillon, 2003). Apart from this, deforestation, industrialization, agriculture focused expansion of specific crops, and everchanging climatic cycles also contributes to the habitat loss of these indigenous crops (Pandit et al. 2003). To add up for overharvesting and its associated effects, the following points might be influential:

- Increasing demand of commercial crops focused on import and export gains.
- Utilizing the harvesting technique with harm to ecosystem and soil nutrient quality for growth of wild and traditional region-specific crops.
- Unpredictable climatic cycles are also a leading factor impacting the production and habitat loss of these crops.

### Urgency for sustainable approach for agriculture

To ensure the availability and accessibility of these fruits for upcoming generations an urgency of community specific plans for management, awareness regarding novel harvesting techniques that are non-destructive harvesting in nature for soil and future crops, and economical benefit-sharing in terms of entrepreneurship and small industry setup opportunities with local population stands tall (Hamilton, 2004). Introduction of umbrella species concept in plant crops could also be a beneficial input in this regard. Further, development of wild plant dedicated agricultural zone will also provide a safe harvesting of these traditional wild plants and fruits. This will not only ensure the safety from genetic erosion of these wild crops but will also provide new market niches to the small regional farmers for economic gains (Dawson et al., 2013). Thus, the trilogy of good agricultural practices, conservation strategies, and ex-situ conservation will ensure the reachability of these gems from one generation to next.

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