

International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(2): 1034-1037
www.biochemjournal.com
Received: 26-11-2025
Accepted: 29-12-2025

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Adlay: A multifunctional millet of the Assam hills

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DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i2Sm.7774>

Abstract

Adlay (*Coix lacryma-jobi* L.), a lesser-known millet, is traditionally cultivated in the Karbi Hills of Assam and other parts of Northeast India. Rich in protein, fiber and bioactive compounds, the crop has high nutritional and therapeutic potential. It is resilient to climatic stresses and thrives on marginal soils, making it suitable for hill farming systems. In addition, this promising crop possesses numerous potential for aesthetic and economical uses. However, limited research, poor processing infrastructure and lack of market linkages have kept it underutilized. This review synthesizes information on its agronomical, nutritional and medicinal properties, cultural importance, current status in Karbi Hills and future prospects. It also identifies research gaps and policy opportunities to mainstream adlay into food and livelihood systems.

Keywords: Adlay, nutritional, therapeutic, medicinal, livelihood systems

Introduction

Adlay (*Coix lacryma-jobi* L.) or Job's tears, locally known as "Tumdak" in Karbi Hills, is an underutilized millet crop with significant nutritional and cultural importance. The plant got its name due to its tear-drop shaped seeds and also depicts the agony and tears of Job mentioned in the Old Testament (Duncan *et al.*, 2019) [7]. Traditionally cultivated in upland and *jhum* fields of Karbi Anglong of Assam, it is valued by local communities for food, beverages and medicinal purposes. Despite its resilience to low-input conditions and adaptability to hill agriculture, the crop has not been integrated into mainstream agricultural or market systems. It has lot of potential for its cultivation in upland hill situations but the neglect of adlay is due to limited research, post-harvest processing challenges and lack of policy support, even though it's potential aligns with the global movement towards climate-resilient and nutritious food systems. It is considered as a minor millet which is also cultivated in Nagaland, Mizoram and Arunachal Pradesh of North East India. In Karbi Anglong, minor millets cover an area of 124 hectares with a production of 104 tonnes and average productivity of 8.46 quintals per hectare (Maibangsa & Doley, 2023) [15]. Adlay is a rich source of carbohydrates, proteins, fats, vitamins, minerals and bioactive compounds.

Table 1: Nutritional composition of Adlay and Foxtail millet:

Nutrient	Adlay	Foxtail millet
	Amount (per 100 g) (Source: Kumar <i>et al.</i> , 2014) [13]	Amount (per 100 g) (Source: Chapke <i>et al.</i> , 2018) [5]
Carbohydrates	65.3 g	60.9 g
Proteins	15.4 g	12.3 g
Fats	6.2 g	4.3 g
Dietary fibres	0.8 g	8.0 g
Phosphorus	435 mg	290 g
Calcium	25 mg	31 g

It is also known as coix millet and is mainly cultivated for food and fodder. It is also known for its different medicinal properties (Acharya *et al.*, 2024) [1]. Grains are either ground into flour, mixed with water and taken as a drink or boiled and eaten with cooked rice. The cooked grains are taken as food or malted and brewed and used as liquor (Burkill, 1953) [4].

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In China and Japan, it is used for preparation of ornaments (Jiang *et al.*, 2008) ^[10]. Coix is highly nutritious with medicinal significance, climate-resilient and less prone to pest and diseases (Devaraj *et al.*, 2020) ^[6].

Botanical features and Suitability

Belonging to the family Poaceae, adlay are of two major types: the edible soft-shelled variety (*C. lacryma-jobi* var. *ma-yuen*) and the hard-shelled ornamental type (*C. lacryma-jobi* var. *lacryma-jobi*) (Pradheep *et al.*, 2014) ^[19]. The soft-shelled form is cultivated in India, mainly in the North eastern hills. However, the hard-shelled types are not popular in India.



Fig 2: Grains of Coix (Source: Self)



Fig 3: Dried panicle of Coix (Source: Self)

Karbi Anglong is bestowed with hills and valleys and its rainfall and temperature are not uniform throughout and depend upon the location of these hills. The average annual rainfall is 1205.22 mm and soil type varies from sandy loam to clay loam texture. The ability of adlay to thrive on marginal soils, tolerate drought and perform well in shifting cultivation systems makes it a suitable crop for its cultivation in this hill district. Farmers mainly cultivate traditional landraces without access to improved varieties and technologies or systematic agronomic guidance, which limits the performance and productivity.

Historical background

Adlay is one of the earliest domesticated crops, native to tropical and subtropical regions of Southeast Asia (Rupitak *et al.*, 2024) ^[20]. In Japan, these seeds were used as prayer beads by the Buddhists monks during meditation and it was introduced in China by a Chinese General as a cereal, which

dates back to the 1st Century. It is one of the oldest cultivated gramineous crop in China (Guo *et al.*, 2020) ^[8] and later, it was distributed in other countries like Japan, Korea, India, Philippines, Malaysia, Myanmar and Thailand. In India, it is mainly grown by the indigenous tribes of Arunachal Pradesh, Mizoram and Nagaland.

Earlier, the hard-shelled wild varieties were used as beads for necklaces, bracelets, jewellery and ornaments by various cultures (Nehal *et al.*, 2015) ^[17], including the ethnic groups of Malaysia and tribal people of Mizoram. Vakira is the traditional headgear of Mizo women and it is usually decorated with adlay seeds (Soni *et al.*, 2023) ^[23].

Uses and importance

Adlay millet is known as a functional crop for its nutritional, medicinal, climate resilient and other economic properties that support livelihood security of the rural people. Though the crop possesses a huge number of significances, yet it has remained as an underutilized crop in this hill district as well as in Assam. Some of its important properties are mentioned below:

Nutritional properties

The grain of adlay or coix is a good source of carbohydrates and proteins. It is rich in minerals, crude fat and bioactive compounds compared to other cereals. In addition, it is gluten free and good for patients with celiac disease. Soups, porridge, salads, desserts *etc.* can be prepared from its grains while the green leaves can be used as fodder. For fodder purpose, crop is cut fresh for fodder purpose at above 12 inches from ground. In Karbi Hills, the crop is traditionally consumed as porridge, roasted snacks and fermented beverages and it is often recommended as a nutritive food for lactating mothers.

Nutritionally, adlay surpasses many cereals with a protein content of 12-15%, carbohydrate levels of 55-65%, 5-7% fat (rich in unsaturated fatty acids) and 6-10% dietary fibre. It also provides important minerals such as calcium, magnesium, and phosphorus (Weng *et al.*, 2022) ^[27].

Medicinal properties

The grains and roots of adlay are considered to have various medicinal traits for its anti-oxidant, anti-inflammatory, anti-fungal and anti-diabetic properties. The grains are used to treat kidney as well as gall bladder stones, menstrual disorders like excessive bleeding or irregular menstruation and catarrhal infection while the decoction of its roots is used to treat dysentery and as an anthelmintic medicine (Jimo *et al.*, 2001) ^[11]. This functional food lowers the risk of cardiovascular diseases and balances the blood cholesterol levels in human. In addition, the seeds are beneficial to treat edema or inflammation in the body (Yu *et al.*, 2011) ^[28] and used to cure arthritis, neuralgia, warts and chapped skin (Shih *et al.*, 2004) ^[21].

The presence of bioactive compounds like coixenolide and coixol enhances its medicinal value, as these compounds are associated with anti-inflammatory, anti-obesity, anti-tumor, and anti-diabetic properties (Huang *et al.*, 2005) ^[9]. Scientific studies also support its pharmacological potential, aligning traditional knowledge with modern evidence. However, it is not suggested to be consumed by pregnant women owing to its abortifacient property (Patel *et al.*, 2017) ^[18].

Climate smart properties

Though it is perennial in nature, adlay is cultivated as an annual grass, basically in *Jhum* areas. This millet is of four to five months duration, able to compete with weeds and is low labour-intensive compared to other cereal crops. It is best suited for hill ecosystems owing to its high tolerance to water logging conditions (Kaur *et al.*, 2025) ^[12], resilience to acidic pH levels (Wang *et al.*, 2023) ^[26] and adaptive to climate change (Suyadi *et al.*, 2019) ^[24]. As such, it can be cultivated as a potential crop in climate smart farming due to its adaptability to marginal lands and harsh environmental situations for both food and fodder purpose.

Economic properties

Adlay is used to make ornaments and adorned by ladies in China and Japan. It is embellished and used by the indigenous tribal women of Mizoram of North east India during festivals. Due to its pearl-like shape, the polished seed is used for crafting and decoration of beautiful jewellerys, rosaries and bracelets. In addition to this, dried plants of adlay are utilized as thatch material in rural areas (Tyagi *et al.*, 2019) ^[25]. It can also be processed for preparation of tea, coffee and wine. Seed extract of coix is a popular ingredient of cosmetic soaps and skincare items that reduce tanning and dermal wound healing (Miftahurromah *et al.*, 2026) ^[16].

Current status in Karbi Hills

In Karbi Anglong, adlay crop is cultivated mainly for household consumption, with only small surpluses reaching local markets. Lack of knowledge on scientific cultivation practices and its importance, absence of processing facilities, value addition and structured supply chains has restricted its commercialization. The tough outer seed coat makes processing labor-intensive, requiring specialized dehulling machinery that is not locally available. Furthermore, adlay has not been prioritized in agricultural programmes such as the National Food Security Mission-Millet (NFSM-Millet), Millet Mission *etc.* and it remains outside procurement and subsidy frameworks facing significant structural and policy barriers, which discourages farmers from expanding cultivation in the recent times.

Opportunities and Prospects

Despite its current neglect, adlay holds great promise for future food and livelihood systems. It can be promoted as a gluten-free, high-protein health food with significant export potential in East Asian countries like China, Korea, and Japan, where it already has a niche market. The crop is climate-resilient and well-suited to low-input hill agriculture, making it ideal for climate-smart farming (Singh *et al.*, 2021) ^[22]. Value addition into products such as flour blends, noodles, malted beverages, breakfast cereals, and nutraceuticals could attract urban consumers. Branding initiatives such as “Karbi Hills Health Millet” and integration with millet promotion schemes would strengthen its market presence and farmer adoption. Central and State Government can also take up initiatives to include it in public distribution and nutritional programmes such as the Mid-Day Meal Scheme.

Cultivation requirements of Adlay

Adlay cultivation can be well adapted to a wide range of soil and climatic conditions. It can also tolerate moisture stress

conditions. It requires a pH range from 4.5 to 8.4 (Bhoomika & Suhas, 2025) ^[2] and ideal average annual temperature for its growth and development ranges from 9.6 °C to 27.8 °C (Kumar *et al.*, 2017) ^[14]. It is mainly cultivated through seeds during *Kharif* season and can also be cultivated during *Rabi* season under assured irrigation facilities. Seed rate ranges from 6 to 10 kg per hectare. The crop grows well in humid subtropical climates with rainfall between 1000-2000 mm, and it matures within 150-160 days. Bidhan Coix-1 is a recommended variety of adlay for hill region of North East India (Biswas & Das, 2022) ^[3].



Fig 4: Coix crop in maturity stage (Source: Self)

Challenges and Research gaps

The primary challenges in promoting adlay include the lack of improved high-yielding varieties and scientific cultivation practices, limited consumer awareness, inadequate processing technologies and weak market linkages. Research on agronomic practices, varietal improvement and intercropping systems under Northeast India's agro-climatic conditions is minimal. The absence of organized procurement systems and inclusion under minimum support price (MSP) schemes further discourages farmers. Additionally, the lack of investment in low-cost dehulling machinery restricts processing and value addition at the community level.

Conclusion and Future Research

There is a huge potential to cultivate adlay millet in Karbi hills to sustain food and nutritional security. This climate resilient crop can be grown in wide range of climatic conditions, even in marginal and degraded lands and tolerant to pests and diseases. The crop needs emphasis on its conservation and research as well as genetic improvements for future to improve yield and income of resource poor farmers. It is required to introduce the cultivation of adlay in such marginal and degraded lands. Focus should be given on processing and value addition of the crop.

Adlay, though underutilized, is a crop of immense nutritional, medicinal and livelihood value for the Karbi Hills. Its resilience to climatic stress and suitability for hill farming make it a potential crop for promoting sustainable and nutritious food systems. With targeted interventions in research, policy and value chain development, this neglected

millet can be transformed into a “future grain” contributing to nutrition security, income diversification and biodiversity conservation. Integrating adlay into India’s millet promotion agenda can unlock its hidden potential and uplift the tribal farming communities of Karbi Anglong.

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