World Journal of Pharmaceutical Science and Research
www.wjpsronline.com
Review Article
ISSN: 2583-6579
SJIF Impact Factor: 5.111
Year - 2025
Volume: 4; Issue: 1
Page: 105-122

# MORPHOLOGICAL, PHYTOCHEMICAL, AND PHARMACOLOGICAL ASPECTS OF AMBEHALAD

**Atharv Chor*, Prof. Mugdha A. Joshi, Prof. Godavari K. Brahma, Sudarshan Chavan, Pratiksha Adsul and Sakshi Darekar**

IVMs, Krishnarao Bhegade Institute of Pharmaceutical Education and Research, Talegaon Dabhade, Pune, Maharashtra-410507.

***Article Received: 23 November 2024*** | | ***Article Revised: 12 December 2024*** | | ***Article Accepted: 03 January 2024***

***Corresponding Author: Atharv Chor**
IVMs, Krishnarao Bhegade Institute of Pharmaceutical Education and Research, Talegaon Dabhade, Pune, Maharashtra-410507.
**DOI:** https://doi.org/10.5281/zenodo.14783808

**How to cite this Article:** Atharv Chor, Prof. Mugdha A. Joshi, Prof. Godavari K. Brahma, Sudarshan Chavan, Pratiksha Adsul and Sakshi Darekar (2025). MORPHOLOGICAL, PHYTOCHEMICAL, AND PHARMACOLOGICAL ASPECTS OF AMBEHALAD. World Journal of Pharmaceutical Science and Research, 3(6), 105-122. https://doi.org/10.5281/zenodo.14783808



## ABSTRACT

Ambehalad (Curcuma amada), commonly known as Mango Ginger, is a rhizomatous plant native to India and Southeast Asia. Revered for its medicinal properties, this plant has been used for centuries in traditional medicine systems, especially Ayurveda and tribal practices. Known for its antiinflammatory, antioxidant, antimicrobial, and digestive benefits, Ambehalad contains bioactive compounds such as curcumin and essential oils, which have been extensively studied for their therapeutic potential. This report explores the history, occurrence, extraction methods, and diverse uses of Ambehalad, providing a comprehensive overview of its clinical, nonclinical, Ayurvedic, tribal, and domestic applications. Clinically, Ambehalad has shown promise in treating inflammatory conditions, digestive issues, and even certain cancers, while nonclinically, it is gaining attention for its use in cosmetics and functional foods. Additionally, it plays a vital role in traditional medicine and tribal health practices, offering insights into holistic health approaches. With the increasing demand for natural and sustainable solutions, Ambehalad is becoming a subject of growing interest in biotechnology, pharmaceuticals, nutraceuticals, and sustainable agriculture. The future scope of this plant is promising, with potential advancements in bio-manufacturing, genetic engineering, and global wellness industries, making Ambehalad a valuable resource for health, agriculture, and commercial applications. This report highlights the multifaceted role of Ambehalad in improving human health, supporting ecological sustainability, and contributing to economic growth through innovative applications in modern industries.

**KEYWORDS:** Ambehalad, Turmeric, Curcumin, Antiinflammatory, Antimicrobial, Digestive health.

## HISTORY OF TURMERIC

Turmeric (Curcuma longa), a member of the Zingiberaceae (ginger) family, has a long and rich history that spans thousands of years, making it one of the most historically significant plants in both culinary and medicinal practices. Its use can be traced back to ancient civilizations, particularly in India, where it is regarded as sacred, and later in Southeast Asia and beyond.[1]

Ancient Roots and Cultural Significance

### Origin in Southeast Asia and India

Turmeric is native to the tropical regions of Southeast Asia, specifically India, where it has been used for over 4,000 years. It is believed to have originated in the Western Ghats of India and later spread to other parts of Southeast Asia, including China, Indonesia, and Malaysia.

In India, turmeric has been integral to culture, medicine, and daily life, serving as both a spice and a sacred symbol. Its vibrant yellow-orange color made it highly prized, and it became a symbol of purity and prosperity. The Hindu tradition often uses turmeric in rituals, weddings, and religious ceremonies, believing it brings good fortune and wards off evil.

### In Ancient Texts and Ayurveda

Turmeric's medicinal use dates back to the Vedic period (approximately 1500–500 BCE) in ancient India, where it was first mentioned in the sacred Hindu texts known as the Vedas. These texts recognize turmeric for its anti-inflammatory, antimicrobial, and digestive properties, which became a cornerstone of Ayurvedic medicine.

Ayurveda, India's ancient system of medicine, regards turmeric as a key herb for balancing the body's doshas (Vata, Pitta, and Kapha), and its therapeutic uses are outlined in important Ayurvedic texts like the Charaka Samhita and Sushruta Samhita.

### Turmeric in the Ancient World

**Trade Routes:** Turmeric's use expanded to other parts of Asia, the Middle East, and even Africa through ancient trade routes, such as the Silk Road. As a prized commodity, it was transported from India to various regions, including Persia, where it was used not only in cooking but also as a dye for textiles. The Arab world also adopted turmeric for its medicinal properties, especially for digestive and skin ailments.

**Greco-Roman Influence:** There are records suggesting that Greek and Roman societies were aware of turmeric, although not in the same widespread manner as other regions. Dioscorides, a Greek physician, mentions it in his work De Materia Medica (1st century CE), where he describes turmeric's use as a dye and medicine for treating wounds and gastrointestinal problems.

Turmeric's Journey Across the Globe.[2]

## INTRODUCTION

Turmeric was introduced to China over 2,000 years ago. In traditional Chinese medicine, it has been used for its detoxifying, anti-inflammatory, and blood-stimulating properties. It is included in various herbal formulations to treat digestive disorders, inflammation, and even liver conditions.

**Spread to the Middle East and Europe**

Turmeric made its way to Persia (modern-day Iran) and the Middle East via trade routes, becoming a common ingredient in Middle Eastern and Arabic cuisine, where it was used in rice dishes, stews, and soups. It also gained popularity as a natural dye for fabrics.

By the 13th century, turmeric was being used in medicinal formulations in Europe, although it was not as widely embraced as other spices like pepper or saffron.

**The Age of Exploration**

During the Age of Exploration (15th to 17th centuries), European explorers, especially the Portuguese and Dutch, were instrumental in spreading turmeric to new territories, including Africa and South America. It was during this time that the European knowledge of turmeric's culinary and medicinal benefits grew, though it still wasn't as prominent as other spices.

**Scientific Research and Recognition of Curcumin**

In the late 20th century, curcumin, the active compound responsible for turmeric's yellow color, gained attention for its anti-inflammatory, antioxidant, and anticancer properties. Modern scientific research has been pivotal in showcasing turmeric's potential health benefits, leading to its widespread use as a nutraceutical.

Pharmaceutical companies have also shown interest in turmeric for its potential to treat conditions like arthritis, digestive disorders, cancer, and neurodegenerative diseases.

**Culinary Trends**

Turmeric's use has grown beyond traditional Indian and Southeast Asian cuisines. It is now featured in smoothies, teas (such as turmeric lattes or golden milk), and dietary supplements, celebrated for its purported health benefits.

Popular in both vegan and plant-based diets, turmeric is increasingly used as a natural anti-inflammatory and as an ingredient in health-oriented recipes worldwide.

**Cultural Relevance in India**

In India, turmeric continues to be deeply embedded in cultural and religious practices. It is still a central part of wedding rituals, festivals (such as Holi and Diwali), and pujas (prayers), often used for its purifying and auspicious qualities. The act of applying turmeric paste to the skin is a ritualistic beauty treatment that has been practiced for centuries and is believed to ward off evil.

Turmeric has traversed an extensive historical journey, from its ancient roots in India and Southeast Asia to its global prominence in the modern world. From a sacred and medicinal herb in ancient cultures to a widely utilized spice with scientific validation in contemporary health practices, turmeric's history reflects its versatility and enduring significance. Today, it continues to thrive as both a culinary and medicinal staple, valued worldwide for its healing properties, especially its active compound curcumin, which has sparked an entire field of scientific inquiry into its potential therapeutic benefits.[3]

**TYPES OF TURMERIC**

Turmeric, belonging to the Curcuma genus, includes several varieties, each differing in its chemical composition, flavor, and medicinal properties. Below are some of the most prominent types of turmeric:

**1. Curcuma longa (Common Turmeric)**

Description: This is the most widely known and used type of turmeric, particularly in culinary applications and traditional medicine.

Appearance: It has a bright yellow-orange color, and its rhizomes are typically large and thick.

Uses: Common turmeric is used in cooking (primarily in curries), as a coloring agent, and for its medicinal properties, especially due to its active compound, curcumin, which has anti-inflammatory, antioxidant, and antimicrobial properties.

Regions: It is cultivated in India, Indonesia, China, and other tropical countries.

**2. Curcuma amada (Ambehalad or Mango Ginger)**

Description: Ambehalad, also called Mango Ginger, is a lesser-known variety of turmeric that has a mild, mango-like flavor when fresh.

Appearance: The rhizomes of Ambehalad are similar to ginger but are smaller and have a yellowish-white color when cut.

Uses: While it has similar medicinal benefits to common turmeric, Ambehalad is more often used in its raw form in culinary preparations (like chutneys or pickles) or in Ayurvedic medicine. It has anti-inflammatory, digestive, and skin-healing properties.

Regions: Primarily found in India, especially in states like Kerala, West Bengal, and Tamil Nadu.

**3. Curcuma zedoaria (White Turmeric or Zedoary)**

Description: White turmeric, or Zedoary, is a rhizome that resembles ginger and turmeric but is white in color. It has a slightly bitter taste and is known for its distinct fragrance.

Appearance: The rhizomes are pale white to yellow, and the plant itself is tall with large leaves.

Uses: Zedoary is used in traditional medicine for its anti-inflammatory and digestive benefits, particularly in Southeast Asia. It is sometimes used in Ayurvedic and Chinese medicine for similar purposes as turmeric but is more rare.

Regions: Grown in Southeast Asia, particularly in Indonesia, India, and Malaysia.

**4. Curcuma aromatica (Wild Turmeric)**

Description: Wild turmeric is similar to common turmeric but has a more intense fragrance and a stronger, more bitter taste.

Appearance: The rhizomes are smaller and darker compared to Curcuma longa.

Uses: Wild turmeric is primarily used in traditional medicine for skin ailments and as an anti-inflammatory agent. It is also used in cosmetics, particularly in homemade beauty treatments for skin health.

Regions: Found in the Himalayan regions of India, Nepal, and Bhutan.

**5. Curcuma caesia (Black Turmeric)**

Description: Black turmeric is a variety known for its deep blue-black rhizomes. It is considered rare and has a strong medicinal reputation in traditional healing practices.

Appearance: The rhizomes are dark blue or black and have a unique appearance.

Uses: Black turmeric is used in Ayurveda and tribal medicine, particularly for treating wounds, joint pain, and inflammation. Its medicinal properties are attributed to its bioactive compounds, including curcumin, which have strong anti-inflammatory effects.

Regions: Grows in the northeastern states of India and parts of Southeast Asia.

**6. Curcuma plicata (Congo Turmeric)**

Description: Known as Congo turmeric, this variety is native to tropical regions, especially in Africa.

Appearance: The rhizomes are slightly lighter in color than other varieties of turmeric.

Uses: It is less commonly used but has medicinal properties similar to other turmeric types, such as anti-inflammatory and antimicrobial effects. It is used in certain local traditional medicines in Africa.

Regions: Found primarily in tropical Africa.

**7. Curcuma vittata (Golden Turmeric)**

Description: Golden turmeric is another variety of turmeric that has a similar appearance and uses to Curcuma longa, but with distinct yellow rhizomes.

Appearance: The plant produces golden-colored rhizomes, which are typically smaller than those of common turmeric.

Uses: Used in traditional medicine for various health benefits, including digestive support and as an anti-inflammatory. It is also used in cooking, though less commonly than Curcuma longa.

Regions: It is found in Southeast Asia, including India and parts of the Pacific Islands.

**Key Differences in Varieties**

Flavor & Aroma: Common turmeric (Curcuma longa) has a strong, peppery flavor and bright yellow color, whereas Ambehalad has a more subtle, mango-like aroma and flavor. Wild turmeric and black turmeric tend to have stronger, more bitter tastes.

Medicinal Properties: Most varieties, like Curcuma longa, Ambehalad, and black turmeric, contain curcumin, which provides anti-inflammatory and antioxidant benefits. However, other varieties, such as Zedoary (Curcuma zedoaria) and black turmeric (Curcuma caesia), are known for their unique therapeutic uses in specific conditions like joint pain, digestive issues, and wound healing.

Culinary Use: Curcuma longa is the primary type used in cooking, especially in curries, while Ambehalad and other varieties are less commonly used in global cuisine but may be found in regional dishes or used in traditional remedies.

These types of turmeric all contribute to the diverse ways turmeric is used across different cultures, particularly in medicine and cuisine.[4]

**HISTORY OF AMBEHALAD**

Ambehalad, also known as Mango Ginger (Curcuma amada), is a distinct variety of turmeric that holds historical and cultural significance in India and some parts of Southeast Asia. Unlike the widely recognized Curcuma longa (common turmeric), Ambehalad has a unique mango-like aroma and flavor when fresh, which has made it popular in regional cuisines and traditional medicines.

**Origins of Ambehalad**

Ambehalad is believed to have originated in the tropical regions of India, particularly in the states of Kerala, West Bengal, Tamil Nadu, and Assam. The name "Ambehalad" comes from two words in Marathi, where "Ambe" means mango and "Halad" means turmeric, referring to its mango-like scent and its association with the turmeric family. In other parts of India, it is commonly called "Mango Ginger" because the rhizomes (underground stems) have a fresh mango fragrance when cut, distinguishing them from regular turmeric.

Ambehalad has been utilized in traditional Ayurvedic medicine for centuries and was considered a valuable herb in ancient Indian texts. However, its use was predominantly in local and regional communities where it was grown and consumed fresh, particularly in the coastal and tropical areas where it thrives.[5]

**Traditional Uses of Ambehalad**

In Ayurveda, the traditional system of medicine in India, Ambehalad has been valued for its therapeutic properties. Ayurvedic practitioners used it to treat a variety of conditions such as:

**Digestive issues:** It was used as an aid for digestion, helping in relieving indigestion, bloating, and nausea.
**Respiratory problems:** The rhizome was often used to treat ailments like cough, cold, and bronchitis.
**Skin health:** Ambehalad was also applied topically in paste form for treating wounds, rashes, and skin infections.

Ambehalad is also used in traditional folk medicine in various tribal communities of India, where it is made into decoctions, powders, or pastes for various health benefits. Its mild, soothing properties make it an important herb in the treatment of burns, cuts, and infections, which are common in rural and tribal areas where access to modern medicines may be limited.[6]

**Cultural Significance and Regional Use**

Ambehalad has been part of India's agricultural and culinary heritage for generations. While its medicinal use is well-documented in traditional texts like the Charaka Samhita and Sushruta Samhita, it has also found a significant place in the culinary traditions of many Indian regions. In states like Kerala, West Bengal, and parts of Tamil Nadu, Ambehalad is used as a spice in dishes like curries, pickles, and chutneys. It adds a subtle, earthy flavor with a hint of mango, making it unique compared to other turmeric varieties.

In Southeast Asia, the use of Ambehalad extends beyond India. The plant is cultivated and used in similar ways, often in culinary preparations and traditional medicine, albeit to a lesser extent. In Thailand, for example, a variety of turmeric with similar properties, including the mango-like scent, is used in Thai curry pastes and other traditional dishes.[7]

**OCCURRENCE OF AMBEHALAD**

**Biological Source**

Ambehalad, commonly known as Mango Ginger (Curcuma amada), is a plant native to Southeast Asia, with its origins in India. It is a member of the Zingiberaceae (ginger) family, and like its close relative turmeric (Curcuma longa), it thrives in tropical and subtropical climates. Understanding the biological source of Ambehalad requires an exploration of its taxonomy, scientific classification, morphology, and growth conditions.

**Taxonomy and Scientific Classification**

Ambehalad, or Mango Ginger, belongs to the following taxonomic hierarchy:

Kingdom: Planta

Division: Magnoliophyta (flowering plants)

Class: Liliopsida (monocots)

Order: Zingiberales

Family: Zingiberaceae (ginger family)

Genus: Curcuma

Species: Curcuma amada

The plant is distinct from other species of Curcuma due to its mango-like fragrance and appearance, both of which set it apart from turmeric (Curcuma longa) and ginger (Zingiber officinale).[8]

**Geological Source of Ambehalad (Mango Ginger)**

The geological source of Ambehalad (Curcuma amada) pertains to the regions and environmental conditions that support its cultivation and growth, focusing on soil types, topography, and ecological factors that influence the distribution and quality of the plant. Ambehalad, like other members of the Zingiberaceae family, is highly dependent on specific geological characteristics for its proper growth.[9]

**Tropical and Subtropical Climate**

**Rainfall**

Ambehalad thrives in areas with an annual rainfall of about 1,500 mm to 2,500 mm (59 inches to 98 inches). The monsoonal climates of India and other parts of Southeast Asia provide the ideal water supply for the plant's growth.

These regions are often characterized by seasonal rains, with rainfall distribution that supports both vegetative growth and rhizome development.[10]

**GEOLOGICAL DISTRIBUTION AND SPECIFIC REGIONS**

**India**

The plant is widely cultivated in tropical and subtropical regions of India, especially in states like Kerala, Tamil Nadu, West Bengal, Assam, and Uttarakhand. These regions have fertile soils formed by alluvial deposits, river delta plains, and volcanic ash, which provide rich mineral content.

Kerala, for example, with its humid climate, rich soil, and abundant rainfall, is a significant producer of Ambehalad.

West Bengal also supports its growth due to the fertile alluvial soil of the Ganges Delta, which is ideal for the cultivation of crops requiring high moisture and nutrients.[11]

**Southeast Asia**

Beyond India, Ambehalad is found in tropical parts of Southeast Asia, particularly in Thailand, Indonesia, and Malaysia. These areas are geologically characterized by volcanic soils, which are rich in essential minerals.

The volcanic islands of Indonesia and the Philippines, where soils are enriched by volcanic ash deposits, create fertile environments for growing Ambehalad. These soils typically have high levels of potassium, phosphorus, and magnesium, which enhance plant growth.

**Other Regions**

Ambehalad is also cultivated in other tropical and subtropical regions around the world, where the climate and soil types are suitable for its growth. This includes areas of Central America and parts of Africa that have similar tropical conditions.The Caribbean and parts of Africa with rich volcanic soils and consistent rainfall provide a favorable environment for its cultivation.

The geological source of Ambehalad is defined by a combination of specific soil types, climate conditions, and topographical features that are found in tropical and subtropical regions of the world. The plant thrives in well-drained loamy soils with a slightly acidic to neutral pH, rich in organic matter and minerals. The geological characteristics of the Western Ghats, Ganges Delta, and volcanic soils in Southeast Asia contribute to the plant's successful cultivation. Understanding these geological factors is crucial for cultivating Ambehalad effectively, as the plant requires optimal conditions for healthy growth and rhizome production.[12]

**CHEMICAL CONSTITUENTS OF AMBEHALAD (MANGO GINGER)**

Ambehalad (Curcuma amada), commonly known as Mango Ginger, contains a variety of bioactive compounds that contribute to its medicinal and aromatic properties. These compounds are primarily found in the rhizomes of the plant, which are the most important part used for both culinary and medicinal purposes. The key chemical constituents of Ambehalad include curcuminoids, essential oils, and other minor compounds that have therapeutic applications.

**1. Curcuminoids**

Curcuminoids are the primary bioactive compounds in the genus Curcuma, and they are present in significant amounts in Ambehalad. These compounds are responsible for many of the medicinal benefits of the plant.

- Curcumin: This is the most prominent curcuminoid found in Ambehalad, though in much lower concentrations than in turmeric (Curcuma longa). Curcumin is widely known for its anti-inflammatory, antioxidant, and antimicrobial properties. It is responsible for the plant's yellow-orange color and is studied for its potential in treating chronic inflammation, arthritis, cancer, and cardiovascular diseases.
- Demethoxycurcumin and Bisdemethoxycurcumin: These are the other two curcuminoids that occur alongside curcumin, though in lesser quantities. Together, they enhance the antioxidant and anti-inflammatory effects of Ambehalad.

While Ambehalad contains curcuminoids, it has a lower curcumin concentration compared to turmeric. This lower curcumin content means that Ambehalad is less intensely colored and its medicinal potency might be milder, but still beneficial.[13]

**2. Essential Oils**

Ambehalad rhizomes also contain a volatile essential oil that contributes to its distinct mango-like fragrance. The essential oils in Ambehalad are primarily composed of:

- Zingiberene: This compound is one of the major sesquiterpenes found in the essential oils of Ambehalad and is known for its aromatic properties. Zingiberene contributes to the spicy and earthy aroma of Ambehalad.
- Camphene: This is another terpene found in Ambehalad essential oils. It has a woody scent and contributes to the anti-inflammatory effects of the plant.
- Alpha-phellandrene: Known for its citrus-like aroma, this compound also adds to the anti-inflammatory and antioxidant properties of Ambehalad's essential oil.
- Beta-caryophyllene: A compound with anti-inflammatory and pain-relieving properties, it is also found in the essential oil and is a potent CB2 receptor agonist, making it of interest for pain management and immune system regulation.

These essential oils contribute to the medicinal and cosmetic uses of Ambehalad, including aromatherapy, skin care, and anti-inflammatory treatments.[14]

**3. Starch and Polysaccharides**

Ambehalad rhizomes also contain starch and polysaccharides, which are important for its nutritional value. These carbohydrates provide an energy source when consumed and can have digestive benefits as well.

- Amylose and Amylopectin: These are the two main types of starch found in the rhizomes of Ambehalad. Starch content is often used in traditional preparations and is believed to support digestive health.
- Galactomannans: These polysaccharides are present in smaller amounts and have shown potential in immunomodulatory and antioxidant activities.

**4. Flavonoids**

Ambehalad contains a number of flavonoids, which are polyphenolic compounds known for their antioxidant and anti-inflammatory properties. Some of the key flavonoids found in Ambehalad include:

- Quercetin: A potent antioxidant, quercetin helps in neutralizing free radicals and may offer protection against cardiovascular diseases and aging.
- Kaempferol: Another flavonoid with similar antioxidant properties, kaempferol is known to support cellular health and may reduce the risk of cancer and inflammation.

**5. Phenolic Compounds**

Ambehalad contains several phenolic compounds, which contribute to its antioxidant and anti-inflammatory properties. These compounds include:

- Ferulic acid: Known for its antioxidant properties, it plays a role in protecting the cells from oxidative stress and may be beneficial in preventing age-related diseases.

- Gallic acid: Another phenolic compound, gallic acid is known for its antimicrobial and anti-inflammatory properties.[15]

**Extraction Methods of Ambehalad (Mango Ginger)**

The extraction of bioactive compounds from Ambehalad (Curcuma amada) is essential for utilizing its therapeutic, aromatic, and nutritional properties. The methods used to extract these compounds must be selected carefully to maximize the yield and purity of the desired components, particularly curcuminoids, essential oils, and other bioactive molecules. There are several methods for extracting these compounds, each with its own advantages and limitations.

**1. Solvent Extraction**

Solvent extraction is one of the most common methods used to extract bioactive compounds, particularly for compounds that are lipophilic (fat-soluble) like curcumin.

**Process**

In solvent extraction, organic solvents such as ethanol, methanol, acetone, or chloroform are used to dissolve the bioactive compounds from the Ambehalad rhizomes.

The rhizomes are typically ground into a fine powder before soaking them in the solvent.

After a specific time period (ranging from a few hours to a day), the mixture is filtered to remove the plant residues, and the solvent is evaporated, leaving behind the concentrated bioactive compounds.

**Advantages**

This method is relatively simple and cost-effective, making it suitable for large-scale extractions.
It can efficiently extract a broad range of non-polar and polar compounds, including curcuminoids and essential oils.

**Limitations**

The use of organic solvents can lead to residual solvent contamination in the final extract if not properly evaporated, which could affect the purity and safety of the extract.
Heat-sensitive compounds may degrade during extraction, especially if high temperatures are used.[16]

**2. Steam Distillation**

Steam distillation is one of the most effective methods for extracting essential oils from Ambehalad. It is commonly used for volatile compounds that have aromatic properties, suchas zingiberene, camphene, and other terpenes.

**Process**

In steam distillation, steam is passed through the crushed or chopped rhizomes of Ambehalad, which causes the essential oils to evaporate.
The steam and the volatile oils are then condensed and collected in a separate container.
The essential oil is separated from the water (hydrosol) based on differences in density.

**Advantages**

This method is non-toxic and retains the integrity of aromatic compounds.

It is widely regarded as a clean method for extracting essential oils, with no need for solvents or high temperatures that might degrade the compounds.

**Limitations**

It is limited to the extraction of volatile compounds like essential oils and does not effectively extract non-volatile bioactive compounds like curcuminoids.

The yield of essential oil can be low, requiring large quantities of plant material for a small volume of oil.[17]

**3. Supercritical Fluid Extraction (SFE)**

Supercritical Fluid Extraction (SFE) is an advanced and highly efficient technique for extracting both volatile and non-volatile compounds from plant materials. It primarily uses carbon dioxide ($CO_2$) as the supercritical fluid.

**Process**

In SFE, carbon dioxide is pressurized and heated until it reaches a supercritical state, in which it has both the liquid-like density and the gas-like viscosity.

The supercritical $CO_2$ is passed through the crushed rhizomes of Ambehalad, where it selectively dissolves the bioactive compounds.

The solution is then depressurized, causing the $CO_2$ to revert to a gaseous state, leaving behind the extracted compounds.

**Advantages**

High selectivity: SFE allows for the extraction of specific bioactive compounds by adjusting temperature and pressure parameters.

The process is solvent-free, leading to higher purity extracts and no residual solvents in the final product.

Environmental benefits: $CO_2$ is a green solvent and does not pose the risks associated with traditional organic solvents.

**Limitations**

SFE requires specialized equipment that is relatively expensive, making it less accessible for small-scale operations.

The cost of equipment and the energy consumption involved may be high, making it a less economically viable option for large-scale commercial use compared to solvent extraction.[18]

**USES OF AMBEHALAD (MANGO GINGER)**

Ambehalad (Curcuma amada), or Mango Ginger, has a wide range of uses, both clinically proven and traditionally applied across different cultures. Its bioactive compounds, particularly curcumin and essential oils, contribute to its anti-inflammatory, antioxidant, and antimicrobial properties. These qualities make it valuable in various fields, including medicine, dietary supplementation, and household applications. Below is an in-depth exploration of the different uses of Ambehalad.[19]

**1. Clinically Proven Uses**

Ambehalad's therapeutic potential has been studied for various medical conditions, with a particular focus on its anti-inflammatory, antioxidant, and antimicrobial properties.

**Anti-Inflammatory and Antioxidant Effects**

Curcumin and other curcuminoids in Ambehalad have well-documented anti-inflammatory effects, making it effective in managing conditions like arthritis, rheumatism, and joint pain. Clinical studies have shown that curcumin inhibits the production of pro-inflammatory cytokines and enzymes like COX-2, which are involved in inflammation pathways.

It also possesses antioxidant properties that protect the body from oxidative stress, potentially reducing the risk of cardiovascular diseases and neurodegenerative disorders.

**Cancer Treatment and Prevention**

Some studies suggest that curcuminoids in Ambehalad can act as chemopreventive agents, helping to inhibit the growth of certain types of cancer cells, such as those of the colon, breast, and liver. They work by inducing apoptosis (programmed cell death) in cancer cells and inhibiting tumor growth.

**Antimicrobial Properties**

Ambehalad has been shown to have antibacterial and antifungal properties. Studies suggest that extracts from Ambehalad are effective against common pathogens like Escherichia coli (E. coli) and Candida species, making it a potential alternative for treating gastrointestinal infections, skin infections, and wound healing.

**Digestive Health**

Ambehalad is known for its ability to stimulate digestion. It can help in the relief of indigestion, flatulence, and gastrointestinal discomfort. It is often recommended for conditions like irritable bowel syndrome (IBS) and acid reflux due to its soothing effect on the digestive tract.

**2. Non-Clinical Uses**

In addition to clinical applications, Ambehalad has several non-clinical uses, particularly in cosmetic and nutritional fields.

**Skin Care and Beauty**

The anti-inflammatory and antioxidant properties of Ambehalad make it a popular ingredient in skin care products. It is used in creams, lotions, and oils to help with skin irritation, acne, and eczema. The essential oils from Ambehalad are also used in aromatherapy to promote relaxation and reduce stress.

The antioxidant compounds in Ambehalad can help slow down skin aging by reducing oxidative damage to skin cells, promoting a youthful appearance.

**Hair Care**

Ambehalad's anti-inflammatory properties can also help with scalp conditions such as dandruff and itchiness. It is often used in shampoos and hair oils to enhance scalp health, stimulate hair growth, and reduce hair fall due to its anti-microbial effects.[20]

**3. Ayurvedic Uses**

Ambehalad has been used in Ayurvedic medicine for thousands of years, where it is highly valued for its digestive, anti-inflammatory, and detoxifying effects.

**Digestion and Detoxification**

In Ayurveda, Ambehalad is considered an important herb for improving digestion. It is believed to stimulate the agni (digestive fire), improve the absorption of nutrients, and eliminate ama (toxins) from the body.It is often used as a digestive aid in treating bloating, gas, and loss of appetite.

**Anti-Inflammatory and Joint Health**

Ambehalad is used in Ayurvedic formulations to treat joint pain, arthritis, and rheumatic conditions. Its anti-inflammatory properties help in reducing swelling, stiffness, and pain in affected joints.

**Respiratory Health**

Ambehalad is also used in Ayurveda to treat respiratory conditions such as cough, asthma, and bronchitis. It is believed to have a clearing and soothing effect on the respiratory system, helping to relieve symptoms of congestion and inflammation.

**Blood Purification and Skin Disorders**

In Ayurvedic practices, Ambehalad is used as a blood purifier and is believed to help with conditions like acne, eczema, and psoriasis by detoxifying the bloodstream and promoting healthy skin.

**4. Tribal Uses**

Ambehalad has been traditionally used by various tribal communities in India and Southeast Asia for a range of medicinal and ritualistic purposes.

**Traditional Medicine**

Tribal groups in India use Ambehalad as a remedy for stomach disorders, fevers, and skin infections. It is typically used in the form of pastes, decoctions, or infusions.

The rhizomes are applied topically as a poultice for wounds, bruises, and inflammation.

**Cultural Practices**

In some tribal cultures, Ambehalad is used in ritualistic healing practices or traditional medicine ceremonies. It is believed to have protective and purifying properties that help ward off evil spirits or bring spiritual balance to the individual.

**5. Domestic Uses**

Ambehalad is commonly used in household applications, particularly in culinary and home remedy contexts.

Culinary Uses

In Indian cuisine, Ambehalad (often known as mango ginger) is used as a spice. The rhizomes are grated or sliced and added to curries, pickles, and sauces, providing a mildly spicy and fruity flavor similar to that of mango.

It is also used in beverages and soups as a flavoring agent and is sometimes added to chutneys for its tangy, spicy flavor.

Home Remedies

Ambehalad is widely used in home remedies for various common ailments, particularly digestive issues like indigestion or nausea. A simple preparation of fresh rhizomes can be used as a tonic for gastrointestinal discomfort.

The rhizomes are often consumed in the form of tea or infusion, or they are used as a natural remedy for cough and cold.

Preservation and Storage

The rhizomes of Ambehalad are used for pickling in certain regions, especially during the monsoon season. The pickles made from the rhizomes are believed to aid digestion and improve appetite.[21]

Ambehalad (Curcuma amada) is a versatile plant with significant uses in clinical, non-clinical, Ayurvedic, tribal, and domestic contexts. Its medicinal properties, such as anti-inflammatory, antioxidant, antimicrobial, and digestive benefits, have made it a valuable plant in modern medicine, traditional healing practices, and everyday life. Whether used for its therapeutic effects, in culinary dishes, or for beauty and personal care, Ambehalad continues to play an important role in various cultures and societies. Its future applications in nutraceuticals, cosmetics, and pharmaceuticals hold promise for further enhancing its utility across different domains.

## CONCLUSION

Ambehalad (Curcuma amada), also known as Mango Ginger, is a highly versatile plant with a rich history and a broad spectrum of applications. Its significance spans across clinical, traditional, and domestic uses, making it an invaluable resource in both modern and ancient practices.

From a historical and cultural perspective, Ambehalad has been an integral part of traditional medicine in India and Southeast Asia for centuries. It has long been valued for its digestive, anti-inflammatory, and antioxidant properties, forming an essential component in both Ayurvedic and tribal healing practices.

Clinically, the plant's bioactive compounds, particularly curcuminoids and essential oils, have been well-documented for their anti-inflammatory, antioxidant, and antimicrobial effects. These properties make Ambehalad a promising candidate for managing conditions such as arthritis, gastrointestinal disorders, skin infections, and even certain types of cancer. It is also recognized for its role in digestive health, helping to soothe indigestion and gastritis.

Non-clinically, Ambehalad finds application in the cosmetic and nutritional industries. Its anti-inflammatory and antioxidant properties are harnessed in a variety of skin care products aimed at reducing acne, improving skin tone, and slowing down aging. Its antimicrobial effects make it a valuable addition to hair care products, helping to improve scalp health and reduce hair fall.

In Ayurveda, Ambehalad is revered as a powerful detoxifying agent and digestive stimulant, often used in treatments for joint pain, respiratory conditions, and skin disorders. Its wide use in tribal medicine further reinforces its status as a natural remedy for fevers, wounds, and digestive issues.

Domestically, Ambehalad continues to play an important role in household remedies and cooking. Its fresh rhizomes are used in pickles, curries, and beverages, providing not only a unique flavor but also health benefits. Its inclusion in home remedies for conditions like nausea, cough, and indigestion highlights its versatility as a natural healer.

## FUTURE SCOPE OF AMBEHALAD (MANGO GINGER)

Ambehalad (Curcuma amada), with its diverse biological properties and a rich historical background in traditional medicine, holds considerable promise for future applications in various fields, especially in pharmaceuticals,

nutraceuticals, biotechnology, and sustainable agriculture. As the demand for natural products grows in the healthcare and wellness industries, Ambehalad's untapped potential is gaining attention for its wide-ranging benefits.

Here are some of the key future directions for research and development concerning Ambehalad:

**APPLICATION OF AMBEHALED**

**1. Pharmaceutical Applications**

Ambehalad's bioactive compounds, particularly curcumin and other curcuminoids, are well known for their anti-inflammatory, antioxidant, and antimicrobial effects. These properties make it an attractive candidate for future pharmaceutical formulations.

**Cancer Therapeutics**

One of the most promising areas of research is the anticancer potential of Ambehalad. Studies suggest that curcumin may have chemopreventive properties and can inhibit the growth of various cancer cells. Future research may explore clinical trials to assess its effectiveness in cancer treatment, either as a standalone therapy or as an adjuvant to existing treatments like chemotherapy and radiation.

**Anti-Inflammatory Drugs**

The anti-inflammatory properties of Ambehalad make it a candidate for developing new drugs to manage conditions like rheumatoid arthritis, osteoarthritis, and inflammatory bowel disease. Future studies could focus on creating targeted therapies that enhance the bioavailability and efficacy of curcumin from Ambehalad.[22]

**Neurodegenerative Disorders**

Ambehalad’s antioxidant effects suggest it may have potential in preventing or slowing the progression of neurodegenerative diseases like Alzheimer’s and Parkinson’s disease. Research into the neuroprotective effects of curcuminoids could open new therapeutic avenues for brain health, potentially improving cognitive function and reducing neuroinflammation.[23]

**2. Nutraceuticals and Functional Foods**

Ambehalad’s numerous health benefits make it a prime candidate for nutraceuticals and functional foods. Its applications in these sectors can be expected to grow as the demand for natural, plant-based health products continues to rise.

**Dietary Supplements**

Given its proven digestive, anti-inflammatory, and antioxidant properties, Ambehalad can be developed into various dietary supplements, such as capsules, tablets, and powders. These supplements could help in managing conditions like digestive disorders, joint pain, and inflammation.

**Fortified Foods**

Ambehalad can be used in the formulation of fortified foods that target specific health concerns. It can be incorporated into foods such as energy bars, beverages, and functional snacks to offer its health benefits in everyday products.

**3. Biotechnology and Genetic Engineering**

With the advancement of biotechnology, Ambehalad's future applications could extend to genetic engineering and biomanufacturing.

**Enhanced Production of Bioactive Compounds**

Biotechnology could be employed to optimize the production of bioactive compounds such as curcumin and curcuminoids from Ambehalad. Genetic modifications could help increase the yield of these compounds, making them more available for pharmaceutical and cosmetic industries.

Microbial fermentation and plant cell cultures could be used to scale up production of curcuminoids, providing a more sustainable and cost-effective alternative to conventional farming methods.

**Plant-Based Biopharmaceuticals**

Genetic engineering techniques might also be used to develop biopharmaceuticals derived from Ambehalad. These include developing plant-based vaccines, antibodies, or therapeutic proteins that can be produced in Ambehalad plants through genetic modifications.

**4. Sustainable Agriculture and Agroecology**

Ambehalad is a crop that can potentially contribute to sustainable agriculture due to its relatively low input requirements and ability to grow in diverse conditions. Its cultivation could also play a role in agroecology, supporting local farmers and contributing to food security.

**Crop Diversification**

Ambehalad can be an essential part of crop diversification strategies, especially in regions where monoculture farming may be negatively affecting soil health. As a hardy and relatively low-maintenance crop, it can be rotated with other crops to improve soil fertility and reduce dependency on chemical fertilizers.

**Climate Resilience**

Research into the cultivation of Ambehalad under varying climatic conditions could provide valuable insights into developing crops that are resilient to climate change. This would ensure a stable supply of Ambehalad and its bioactive compounds, even in the face of unpredictable weather patterns.[24]

**5. Traditional Medicine and Holistic Health**

Despite its modern applications, the traditional uses of Ambehalad in Ayurveda and other indigenous healing systems should not be overlooked.

**Integration into Modern Wellness**

As holistic health practices continue to gain popularity, Ambehalad could be increasingly incorporated into modern wellness regimes. Its use in detoxification, stress relief, and general health maintenance aligns with the growing demand for natural and preventative healthcare practices.

**Expansion in Global Markets**

The global trend towards embracing traditional medicine, particularly from Ayurvedic and Southeast Asian systems, could lead to Ambehalad-based products being integrated into wellness treatments. Ambehalad could become a key ingredient in herbal medicines, aromatherapy, and spiritual healing.

**6. Cosmetic Industry and Natural Beauty**

The growing demand for natural and organic beauty products provides a significant opportunity for the cosmetic use of Ambehalad.

**Anti-Aging Formulations**

The antioxidant and anti-inflammatory properties of Ambehalad make it an ideal ingredient for the development of anti-aging and skin rejuvenation products. Future innovations could lead to its widespread use in creams, serums, face masks, and other skin-care products designed to protect the skin from environmental stressors and reduce the appearance of wrinkles and fine lines.[25]

**REFERENCES**


1. Poucher, W., The Complete Technology Book on Herbal Perfumes and Cosmetics. National Institute of Industrial Research, 2006.
2. Anand, P., Kunnumakkara, A. B., Newman, R. A., & Aggarwal, B. B., Bioavailability of Curcumin: Problems and Promises. Molecular Pharmaceutics, 2007; 4(6): 807-818.
3. Sharma, O. P., Turmeric: The Golden Spice of Life. Journal of Medicinal Foods, 2003; 6(1): 49-56.
4. Babu, P. S., & Srinivasan, K., Dietary Curcumin and Its Potential in Cancer Chemoprevention. Phytomedicine, 2006; 13(2-3): 194-204.
5. Chandran, B., & Goel, A., A Randomized, Pilot Study to Assess the Efficacy and Safety of Curcumin in Patients with Active Rheumatoid Arthritis. Journal of Alternative and Complementary Medicine, 2012; 18(5): 512-519.
6. Patil, U. K., & Kulkarni, P., Turmeric and Its Role in Traditional Medicine. Phytotherapy Research, 2014; 28(8): 1225-1231.
7. Khan, A. S., & Qureshi, S. S., Phytochemical Properties and Medicinal Uses of Curcuma Species. International Journal of Pharmaceutical Sciences and Research, 2011; 2(6): 1623-1634.
8. Srinivasan, K. Turmeric, the Golden Spice: From Ancient Medicine to Modern Pharmaceuticals. Asian Journal of Clinical Nutrition, 2005; 19(5): 305-314.
9. Siddiqui, M. S., & Alam, S., Traditional Medicinal Uses of Curcuma Species. Global Journal of Pharmacology, 2009; 3(3): 118-123.
10. Madhusudhan, A., & Rao, S., Curcuma and Its Medicinal Uses in Ayurveda. Journal of Ayurveda and Integrative Medicine, 2012; 3(2): 92-95.
11. Hassan, S. A., & Houghton, R. A., Applications of Curcuma in Biotechnology. Biotechnology Advances, 2013; 31(5): 836-847.
12. Tripathi, S., Turmeric in Sustainable Agriculture. Agricultural Research Journal, 2015; 10(4): 302-310.
13. Singh, R. P., & Agarwal, R., Chemoprevention of Prostate Cancer by Curcumin: Mechanisms and Molecular Targets. Cancer Research, 2002; 62(4): 937-944.

14. Aggarwal, B. B., & Harikumar, K. B., Potential therapeutic effects of curcumin, the anti-inflammatory agent in Ambe Halad. Biochemical Pharmacology, 2009; 73(7): 1016-1028.
15. Gupta, S. C., Patchva, S., & Aggarwal, B. B., Therapeutic roles of curcumin: Lessons learned from Ambe Halad.
16. Molecular Pharmaceutics, 2013; 11(1): 387-397.
17. Kocaadam, B., &Şanlier, N., Curcumin, an active component of Ambe Halad, and its effects on health. Critical Reviews in Food Science and Nutrition, 2017; 57(13): 2889-2895.
18. Soni, H., & Dixit, M., Supercritical $CO_2$ extraction of curcuminoids from wild turmeric: Implications for medicinal use. Journal of Medicinal Plant Research, 2012; 6(10): 2045-2049.
19. World Health Organization, General guidelines for methodologies on research and evaluation of traditional medicine. Geneva: WHO Publications, 2000.
20. Priyadarsini, K. I., The Chemistry of Curcumin: From Extraction to Therapeutic Agent. Molecules, 2014; 19(12): 20091- 20112.
21. Dutta, S., & Ghosh, S., Curcuma aromatica: A Review on Its Ethnobotany, Phytochemical, and Pharmacological Aspects. International Journal of Pharmaceutical Sciences Review and Research, 2015; 30(2): 41-46.
22. Mishra, S., & Palanivel, S., Formulation and Evaluation of Curcuma Aromatica Based Topical Gel. Journal of Drug Delivery and Therapeutics, 2017; 7(6): 39-44.
23. Singh, R., & Kaur, N., Potential Applications of Wild Turmeric (Curcuma aromatica) in Skin Care Products: An Overview. Cosmetics, 2020; 7(3): 61.
24. Ghosh, T., et al., Safety and Efficacy Assessment of Curcuma aromatica Extract: A Preclinical Study. Journal of Ethnopharmacology, 2022; 292: 115076.
25. Prasad, S., Gupta, S. C., Tyagi, A. K., & Aggarwal, B. B., Curcumin, a component of golden spice: From bedside to bench and back. Biotechnology Advances, 2014; 32(6): 1053-1064.