

## Traditional and modern approach of preservation and conservation of Buddhists Manuscripts

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### Abstract

The preservation of manuscripts and rare Pali writings is crucial for conserving the cultural, religious, and intellectual heritage of South and Southeast Asia. These items, often written on fragile organic medium such as palm leaf, birch bark, or handmade paper, are very prone to deterioration from environmental influences, biological agents, and human interaction. This study explores the primary problems impacting the long-term survival of these manuscripts and evaluates both conventional and contemporary preservation strategies. Emphasis is given on preventive conservation techniques, including climate control, secure storage, controlled handling practices, and digitisation projects. The article also covers community-based preservation initiatives and how contemporary technology, including machine-assisted restoration and high-resolution digital imaging, can increase access while reducing physical harm to original manuscripts. This study demonstrates comprehensive strategies to guarantee the survival and availability of rare Pali texts for future generations by mixing scientific conservation techniques with knowledge of traditional manuscript cultures.

**Keywords:** Manuscript, pali, palm leaf, deterioration, preservation

### Introduction

For the development and preservation of any nation's art, history, and culture, manuscripts are essential resources. One of the first types of written media, palm leaf manuscripts were employed in Southeast Asia to preserve early recorded information on topics including astrology, Buddhism, and medicine. As unique records of knowledge, palm leaf manuscripts make up our most valuable national legacy. Our literary, linguistic, artistic, and cultural legacy can be effectively preserved through these manuscripts. Several hundred-year-old palm leaf manuscripts about astronomy, astrology, mathematics, medicine, art and architecture are still available for reference today. Manuscripts made of palm leaves usually endure for several centuries, but as time goes on, the leaves deteriorate and the text becomes unreadable.

Myanmar, Indonesia, Malaysia, India, and especially Sri Lanka. Palm leaf manuscripts are the most important historical sources in Sri Lanka and can be found in temples, monasteries, the National Museum, the National Archives, the National Library, university libraries, and special libraries throughout the country (Kumara *et al.*, 2024). Most of these manuscripts belong to various subjects, such as Buddhism, history, archaeology, traditional medicine, rituals, and astrology. The oldest Pali manuscript that has survived dates to the eighth or ninth century and is from Nepal. It's crucial to remember that this document from the ninth century is still on palm leaves rather than paper. The oldest Pali texts would have been written on palm leaves because paper was not brought to the area until the thirteenth century. Since very few manuscripts older than 400 years have survived from Theravada countries (such as Sri Lanka and Southeast Asia), the survival of this specific manuscript in Nepal is noteworthy. This old literature was preserved thanks to Nepal's cooler, drier environment.

### Types of material used for Pali Manuscripts Palm Leaves

In every South Asian nation, including India, Sri Lanka, Nepal, Myanmar, and Indonesia, palm leaves were one of the primary and most widely used writing materials. India cultivates three species of palm trees, which are known by their botanical names:

1. *Corypha umbraculifera*, found in Rajasthan and Gujarat
2. *Corypha Faliera* found in South India's coastal regions
3. *Borassus Flabellifera* found in South India.

Palm leaves (such as Talipot and Palmyra), birch bark, and occasionally metal plates (gold, silver, or copper) or cloth, bound by wooden covers, were the main materials used in Pali manuscripts. The ink was created from plant extracts and soot, and it was all shielded by oils and herbs. The

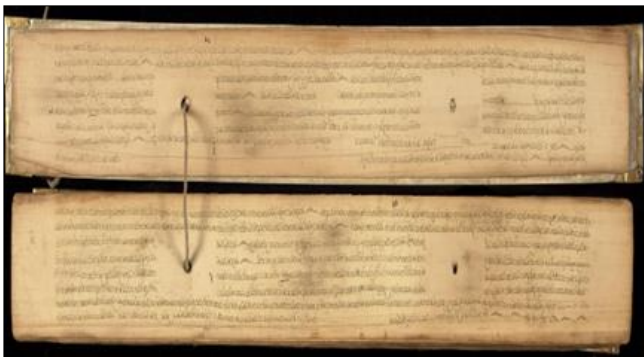


Fig 1: Pali Manuscripts (Manchester Digital Collections)

### History of Manuscripts

Palm leaves were a widely used and important writing material in South and Southeast Asian countries before the invention of paper. Palm leaves were one of the first writing materials used in coastal countries, including Thailand,

Talipot palm, or *Corypha umbraculifera*, is a type of palm utilised for leaf manuscripts that is indigenous to eastern and southern India as well as Sri Lanka. The frond of the talipot palm comprises 80–100 parts and is longer than 10 feet. There are 205 types of the palm tree *Corypha umbraculifera* used for manuscripts. Nishanthi and Wijayasundara (2022) <sup>[15]</sup> claim that ancient people employed palm leaves to compose significant, durable, and high-quality writings in a variety of religious, linguistic, and royal domains.

Three types of Talipot, or palm leaf, are identified on the Indian subcontinent: Talipot palm, Palmyra palm, and Lonta palm. According to Bandara (2020) <sup>[4]</sup>, palm leaf manuscripts are made from the leaves of two species of trees that grow in Sri Lanka: The Talipot and the Palmyra tree. The Thalipot palm, the Palmyra tree, and the Lonta palm are the three varieties of palm leaf-producing trees mentioned by Lagamuwa (2006). According to him, the Palmyra tree is more frequent in hot regions and the Thalipot tree is more abundant in cold climates. According to Wijayawardena (2015) <sup>[20]</sup>, the Talipot palm's abundance is the primary cause of the origin of palm leaf manuscripts in Sri Lanka. The Palmyra palm (*Borassus flabellifer*) is the second variation.

These enormous palms have a maximum height of 30 meters (98 feet). The leaves are two to three meters long and fan-shaped. *Borassus*, which mainly consists of two important species: *Borassus aethiopum* (African Palmyra Palm), which is widely distributed in Africa, and *Borassus flabellifer* (Asian Palmyra Palm), which is essential for food and materials in South and Southeast Asia. The most well-known *Borassus* species are *B. flabellifer* and *B. aethiopum*, which are frequently referred to as sugar palms or fan palms. Other lesser-known species include *B. akeassii*, *B. heineanus*, and *B. madagascariensis*.



**Fig 2:** *Borassus Flabellifera*

### **Bhojapatra**

One of the most widely used writing materials in North India was Bhūrjapatra, also known as Bhojapatra (Birch

Bark). Bhojapatra comes in four different kinds. Black birch (*Betula Lenta*) is found in North America, White birch (*Betula Parifera*) is found in North East Canada, and Himalaya silver birch (*Betula Utilisis*) is found in the Himalaya. Yellow birch (*Betulaluta*) is primarily planted in England and Georgia. In Himalayan regions, particularly Kashmir, the inner bark of this tree was utilised for writing. There are multiple thin layers that make up the inner bark. Each of these meticulously separated layers is as thin as manifold paper. The sheets have a crimson interior and a white or pinky white outside. After applying oil to the bark's surface and allowing it to gently dry, the surface is polished by rubbing it with a polishing stone.

Next, trim the sheet to the desired size and write on it. Made of cellulose, lignin, natural gums, and essential oils, it peels off in fine layers and is as flexible as paper. Before being wrapped between two wooden coverings, holes are made in the middle of the birch bark sheet so that a cord can flow through and keep them together. One significant feature of birch bark is its ability to repel insects. The birch bark is difficult for fungus to attack.

### **Bark Kumbhuki**

Kumbhi bark, which was used as writing material in ancient India, is the bark of the Kumbhi or Kumbhika tree (*Careyaarborea*). Due to the abundance of Kumbhika trees in Orissa's forests, Kumbhika is most commonly used in these areas.

### **Agarutvak (Sāñcipaṭ)**

The tall, aromatic agaru, aguru, or aloe tree (*Acqulairaagullocha*) is typically found in mountainous regions, particularly in Assam. It is referred to as Sāñcī in Assam. Numerous Sāñcipaṭ manuscripts have been found in Assam. Cellulose and lignin make up agaru bark. Ink is absorbed by it. Before curing, seasoning, and polishing, sheets are let too dry for many days. After that, they are treated with orpiment to protect them from insects and rubbed smooth using a conch shell. Both organic and artificial colours are used in painting.

In addition to a unique ink known as "Sāñcī Mahī," carbon and iron gall ink are employed according to the manuscript's specifications. There is no proof that the Agarū, also known as Akil, is used as writing material in Malayalam; it is also present in Kerala's forests.

### **Metals**

The most common metals used for writing are copper, gold, and silver. Tāmra-paṭa, also known as Tāmra paṭṭika, patra, phalaka, sāsanapatra, dānapatra, etc., is the name of the copper plate. Between the sixth and fifteenth centuries, copper was used often, and in South India, this frequency increased later. The Jātaka stories demonstrate how poetry verses of moral sayings were preserved in those days using gold plates, or Suvanṇa patta. Writing on gold dates back to a very early era. There are extremely few examples of writing on silver that have been found to date. In addition to silver coinage, some silver-sheeted documents have been found in stūpas at Bhattiprolu in Taxila.

### **Paper**

In 105 CE, Tsai Lun of China invented paper. Additionally, the Persian Mughal emperors brought it to India. At that time, the majority of government papers started to be

written on paper. Due to its widespread use in the royal courts and its ease of importation, paper has since gained widespread popularity throughout India and eventually supplanted other writing materials with the advent of printing. The other Sanskrit words for paper are kakala, saṅapatra, kākala, and kākali. Nepal is home to the oldest paper manuscripts of Buddhist scriptures that have survived, which date to the 11th and 12th centuries CE and include both Pali and mixed Pali-Sanskrit.

simplicity of writing, carrying, filing or using as a book, storage, and convenience of locating the required writing tools.

**Cause of Deterioration**

On paper, each of these elements acts concurrently rather than separately. In the end, we only witness their combined efforts. In addition to natural factors like light, fungi, insects, climate, etc. The paper is also harmed by a number of man-made problems. Improper storage is the single most destructive element of degradation, according to observations. Floods and fires can also cause unintentional damage. Manuscripts were being purposefully destroyed by invaders in the past.

**Physical Factor**

Particles, heat, fire, water, moisture, and light are the physical factor for deterioration.

**Light**

It can be roughly divided into two categories: artificial light and natural light. Cosmic rays, gamma rays, X-rays, ultraviolet, infrared, and visible light rays make up natural light. The paper's cellulose bond is impacted by ultraviolet radiation from the sun and other sources, which also harms the leaves. The ultraviolet light also fades away the writing inks. Chemical degradation is indirectly triggered by light. The type, intensity, and duration of light exposure all affect how much manuscripts deteriorate as a result of light. The damage increases with decreasing wavelength and the amount of UV energy in light. The harm increases with exposure intensity and duration.

**Heat**

The heat ages paper and can do significant harm to it over time. In general, it can be said that exposure to high temperatures, even for brief periods of time, will make paper brittle and yellow, whereas low temperatures will typically slow down the ageing process. One of the three elements required for mould growth is heat, along with food and moisture. Warm buildings are ideal for rats and insects. The repository's temperature must be kept at a minimum of 40 degrees Celsius. A temperature that is too low will cause microorganisms to proliferate, and a temperature that is too high will cause organic material to break.

**Moisture**

Paper and vellum require a specific amount of moisture to be flexible. Too little moisture causes paper to become brittle, whereas too much moisture promotes the formation of mould. The deterioration of paper things is greatly influenced by water in vapour form. Because paper is a hygroscopic material, it collects water in humid environments and releases it in dry ones. It loses its rigidity and becomes limp in humid conditions. Additionally, high humidity promotes the development of microorganisms. The best conditions for preserving paper records are between 20 and 24 degrees Celsius and 55 percent relative humidity. Nonetheless, this kind of climate needs to be preserved all year long. If stored in a regulated environment, even low-quality paper can last for a long time.

**Human factor**

Negligence and unawareness, mishandling, writing with ink, bad cleaning, and improper storage are the human factor for deterioration.

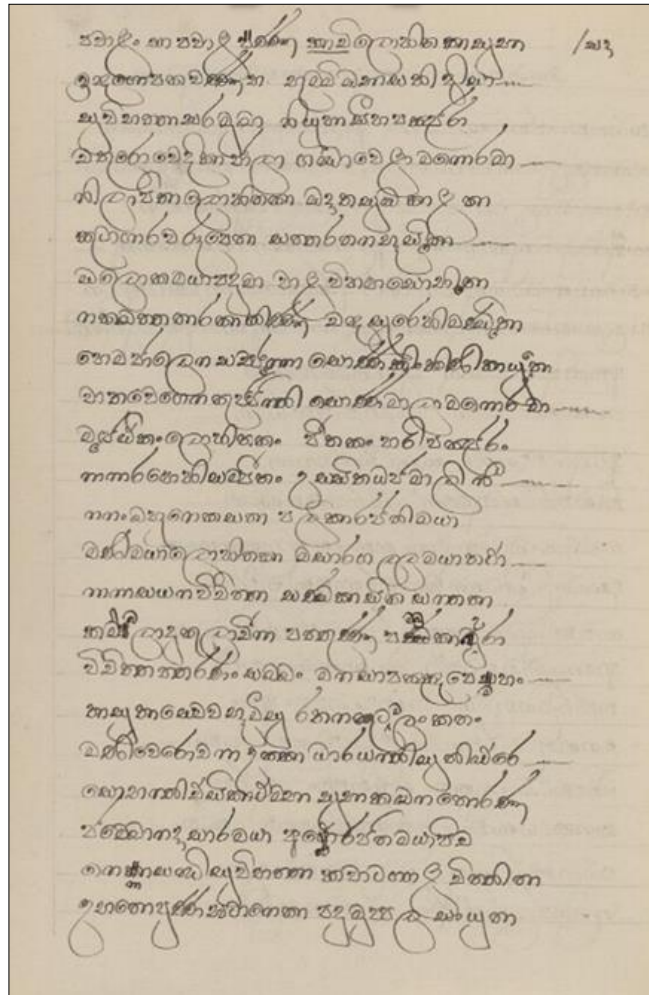


Fig 2: Pali Manuscripts (Manchester Digital Collections)

**Factors for Selecting Material**

It's difficult to get appropriate natural leaves for writing, and not all kinds of leaves are ideal. Selecting the appropriate kind of leaf is also difficult. When selecting the appropriate leaf type for writing in manuscripts, there are a number of things to take into account. According to Wimalakanti (2019) [22], despite having a rough surface, palm leaf manuscripts gained popularity as a writing medium due to their accessibility. According to Deepanjani (2007) [8], a number of factors have influenced the choice of palm leaves for palm leaf manuscripts. For example, palm leaves have gained popularity as a writing medium because they are readily available, easy to prepare for writing, long-lasting, portable, easy to handle, and easy to store. According to Alahakoon (2006) [1], people picked palm leaves for writing because they are more durable, wider, softer, and have a high degree of elasticity when dried. Senadeera (1992) [17] states that the original materials used for the palm leaf manuscripts were selected based on the following criteria:

## **Negligence of Human**

Manuscripts may sustain harm if they are handled carelessly while being transported. Second, manuscripts may sustain irreversible harm if they are poorly conserved. Manuscripts can be harmed by friction; therefore, improper cleaning is equally dangerous.

## **Chemical Factors**

Dust, Pollution, Acidity, oxidation etc., are the chemical factors for deterioration.

### **Acidity**

Acid is the most destructive type of degradation. There are two possible sources of acidity in paper: intrinsic and extrinsic. During manufacturing, intrinsic acid is introduced, such as when bleaching chemicals are left in due to insufficient washing. Sulphur dioxide is the most prevalent external cause of acidity in

### **Dust**

Dust reduces the strength of paper by acting as an abrasive that breaks down the fibres. Additionally, dust serves as a nucleus for atmospheric condensation.

### **Atmospheric Pollution**

Smoke, industrial and exhaust effluents in the form of solid particles, gas pollutants, and liquid aerosols are among the air pollutants that deteriorate manuscripts, books, etc. Irreversible stains may result from them. Paper is negatively impacted by gases such as sulphur dioxide (SO<sub>2</sub>), carbon dioxide (CO<sub>2</sub>), hydrogen sulphide (H<sub>2</sub>S), and dust and dirt particles suspended in contaminated air.

### **Biological Factors**

Micro-organisms, Fungus, Insect, Silver Fish, cockroach, Book Worms, Lice in Books, Wasps, Termite and Rodents are the biological factors for deteriorations.

Biological agents cause the majority of the harm in tropical areas. Fungi, bacteria, algae, yeast, and protozoa are the most significant biological organisms. The materials are harmed by insects like bookworms, silverfish, and cockroaches. Rats and rodents are additional biological agents. Microorganisms can even harm manmade materials.

### **Microorganisms**

Microorganisms, particularly bacteria and organisms resembling bacteria, have very long history. However, this causes man to have troubles. The microorganisms are present in all kinds of feasibilities and have the ability to travel great distances by air or water. They can live in a variety of settings, including the atmosphere, the ground, and underwater. They even become resistant to chemicals that are harmful to them. As a result, the majority of them contribute to the deterioration of materials, particularly those found in libraries and archives. Therefore, understanding the nature of microorganisms and how they reproduce is the first step in dealing with them.

### **Attacks by fungal**

The most frequent cause of all kinds of organic material is fungus. The paper is very vulnerable to fungus, sometimes referred to as mould or mildew, because it is extremely fragile and hygroscopic. They may grow in a variety of environments and on any kind of material. Fungi rely on

other organic material, whether it be living or dead, to survive because they are unable to make their own nourishment. As a result, they pose a threat to the materials they possess.

Particles in the air include fungus, mildew, and mould. When palm leaf manuscripts are kept in warm, humid conditions, mould is a regular problem. They grow horizontally on the surface of damp wood, paper, and other materials, deforming them as they settle. The stuff that fungi grow on is harmed by them. On paper, leather, and fabrics, fungus deteriorates and leaves stains. Even for brief periods of time, air with a moisture content exceeding 75% promotes the growth of mould. In the event that fungus develops between leaves, they adhere to one another and are normally impossible to separate without causing harm to the leaves.

### **Insects**

It has been determined that over seventy different types of insects are detrimental to library materials. Cockroaches, silverfish, firebrats, termites, book-lice, book worms, mud wasps, moths, and bedbugs are the most prevalent of them.

Below are succinct descriptions of their traits:

#### **1. Silver Fish**

Silver fish typically consume foods that are high in proteins and carbs. Silverfish prefer materials like paper, glue, and gelatin. They like the dark. They chew holes in pictures, texts, and paper. The insect gets its name from its silver-grey hue and fish-like shape, which tapers backward. It bores holes in books and enjoys gum, gelatin, and starch, which is used to smooth the writing surface.

#### **2. Cockroach**

Common indoor pests, cockroaches are often seen in museums and libraries. Although the Blattidae family of insects is included under this term, it typically refers to a single species, the black beetle. Libraries all throughout the world, particularly those in hot climates, have three different types. These are either brown or brownish black. Paper leaves, book bindings, leather textiles, and other organic materials are all harmed by shiny insects. Through the covering cloth of the paper and leather binding, they consume paste flue from the back of the book cover. Additionally, their black excrement is deposited on books and manuscripts, discolouring them and altering their look.

#### **3. Book Worms**

The term "book-worm" can refer to any worm found in a book, although it is typically used to describe the larvae of many types of beetles. The beetle deposits its eggs on book margins. The larva burrows both horizontally and vertically into the book or bundle of palm leaves. Another species that destroys books is *Lyctus brunneus*, which is known as ghoon (ghuna) in India. Paper records, books, archive artefacts, etc. are considered to be seriously threatened by book warming. These book worms' larvae and beetles are typically found in dimly lit areas. The edges of books are where these bugs deposit their eggs. The larva burrows into the pages of the book or text as it consumes it.

#### **4. Lice in Books**

Small grey or pale yellow insects with soft bodies and well-developed jaws for chewing are known as booklice. By

consuming the glue or paste they damage the book bindings. These tiny insects of the order Corrodentia attack books, and they are particularly prevalent in late summer when the temperature and relative humidity are high. Another name for them is Phocis. Wood-boring beetles are another type.

## 5. Termite

Tropical and subtropical regions are ideal for termite growth. Even so, they are occasionally referred to as "white ants" despite their outward appearance. Termites are either dark brown or pale yellow in appearance. Termites have delicate bodies and are modest in size. Nevertheless, they consume a lot of cellulose. They are choosy feeders, though. Therefore, it is not necessary for these insects to cause harm through eating. It could be caused by the holes they dug through or by corrosion brought on by moisture or human fluids. They infiltrate wooden shelves, including architectural elements of structures, cabinets, doors, etc., and attack from behind bookcases and cupboards. Termite infestations can quickly destroy and damage books and manuscripts. They can target any kind of cellulose-containing substance.

## 6. Wasps

Books are not a food source for wasps. To construct its nest, one type drills holes in wood. The other kind, known as mud wasps, constructs mud nests that adhere firmly to surfaces. If these nests are constructed around the edges of the books, they may be damaged or deformed.

## Rodents

Anything composed of paper, leather, vellum, glue, paste, gelatine, etc. is severely damaged by rodents. Manuscripts can't be fixed and returned to their original state because they are destroyed by cutting them into pieces. Rats are known to attack and destroy books and manuscripts. They can readily drill holes in wooden cabinets and masonry walls.

## Accidental factor

Floods and fire etc. are the accidental factors for deterioration.

## Flood

Water damage is caused by floods and other factors. Paper items should be transported to a drier location—ideally one where heat and humidity can be controlled—in the event of an emergency, such as floods, strong rain splashing into the building, roof leaks, burst drainage pipes or water from firefighting operations. After that, the conservator would have to deal with three issues at once: repair, fungus treatment, and drying.

## Fire

In a short period of time, fire can cause the most harm to museum artefacts, particularly those made of paper. Therefore, it is essential to take precautions to prevent fire. Periodically, electrical wiring should be inspected. Paints, varnishes, polishes, oil, organic solvents, and cleaning fluid are examples of combustible chemicals that should ideally be kept outside the museum building. Additionally, smoking should not be allowed in exhibition galleries, storage spaces, or packing areas. To detect fire, automatic alarms should be placed at strategic locations. Regular testing is necessary to

verify their functionality. Fire extinguishers need to be placed prominently.

## Preservation of Manuscripts

There are various types of equipment needed for the process of preservation of Manuscript.

## Traditional Preservation

In the past, it was traditional to use herbs and other natural products—which were highly powerful and non-toxic to humans—to combat the bio-organism. The storage boxes were constructed of hardwood; insects were kept at bay. Red cotton cloth was used to wrap the manuscripts. As an insect repellent, a mixture of cumin, cloves, pepper, cinnamon, and camphor was used, albeit it occasionally needed to be changed. Insect-repelling qualities may even be present in snake slough and peacock feathers. In order to improve flexibility and prevent pest attacks, it was also customary to apply citronella oil to palm leaf manuscripts. Additionally, turmeric has been applied to palm leaves and used to colour the covers and binding cords. To keep the lice away, dried neem tree leaves were placed in between the two. Some that are made by burning chamber oil work incredibly well as fungicides and insecticides. Insects from manuscript collections have also been repelled with a blend of clove and camphor.

## Citronella oil

Citronella (*Cymbopogon*) oil is an essential oil that contains a concentrated hydrophilic liquid extracted from the leaves and stems of various *Cymbopogon* species, also known as lemongrass. Citronella oil is used as a temporary repellent.

## Cedar Wood oil

Himalayan cedar (*Cedrus deodara*) is found abundantly throughout the Western Himalayas. Among the major chemical constituents, himachelenes and atlantones have been reported to effectively repel storage pests and houseflies (Adams 1991).

## Ajvain

Ajvain, also known as Ajowan (*Trachyspermum ammi* L. Sprague), is an annual herb belonging to the Apiaceae family. It is indigenous to India and has a thyme-like scent due to the presence of thymol, a naturally occurring class of chemicals having antibacterial and biocidal qualities.

## Clove/Clove Oil

Cloves (*Syzygium aromaticum*) are used to extract essential oil. Eugenol and caryophyllene, the two main constituents of clove oil, have antibacterial, fungicidal, antiviral, and insecticidal qualities.

## Sandalwood/Sandalwood oil

The two santalols,  $\alpha$ -santalol and  $\beta$ -santalol, which have antifungal, antibacterial, and antioxidant qualities and prevent insect growth, are the primary components of sandalwood, which is extracted from the plant *Santalum album* L., which is indigenous to the mountains of Southern India.

## Nirgudi

Vitex Negundo, or nirgudi, is a significant medicinal plant that grows all over India. It has insecticidal qualities in its leaves and seeds.

### **.Camphor/Camphor oil**

The oil derived from *Cinnamomum camphora* contains D-camphor, 1-8-cineole,  $\alpha$ -terpineol, 3-methyl-2-butenic acid, and oct-3-en-2-yl ester, which are powerful insecticides and fumigants. Another natural compound, camphor (Karpura), is often used in India to protect sensitive documents. It is maintained inside the manuscript storage area, packed in little cloth sacks. Additionally, synthetic camphor oil is used to protect palm leaf manuscripts against insect infestation.

### **Sweet Flag or Calamus**

Calamus/Bach Gorbach, often known as sweet flag, is a tall perennial wetland monocot belonging to the genus *Acorus* in the *Acoraceae* family. A popular medication, the dried rhizome is typically infused. The dried rhizome is useful as a pesticide and has fragrant and anti-spasmodic qualities. The plant material serves as an insect repellent and was frequently stored adjacent to manuscripts made of palm leaves.

### **Turmeric**

*Curcuma longa*, sometimes known as turmeric or haldi, has been used medicinally for almost 4,000 years. It is a rhizomatous herbaceous perennial plant that is indigenous to tropical South Asia and is a member of the ginger family *Zingiberaceae* (De Souza Tavares *et al.* 2016). Manuscripts made from palm leaves have been processed and preserved using turmeric paste. In addition to the paste, the dry rhizome is utilised as an insecticide (Jeyaraj 2006).

### **Datura**

The genus *Datura* (*Datura stramonium*) is a member of the *Solanaceae* family of poisonous vespertine flowering plants. They are utilised as hallucinogens and include poisonous or narcotic alkaloids.

### **Cow Urine**

For five to six hours, the manuscripts should be submerged in cow urine and increases its durability. Insects and vermin are repelled by it. It can be applied to weatherproof manuscripts.

### **Neem Leaves and Neem Oil**

In most tropical and subtropical regions of the world, neem (*Azadirachta indica*) is grown as a raw material for natural pesticides and medicinal uses. The primary factor for the harmful effects on insects is azadirachtin, a limonoid and complex tetranortriterpenoid molecule. Limonoids, a type of molecules found in neem oil, function as growth regulators or anti-feed ants in insects; they destroy an entire generation of insects by stopping the maturation of the young and the reproduction of the adults. Insects can also be repelled by dried neem seeds and leaves. Thus, its application has been generally acknowledged since antiquity.

The neem leaves are first boiled in order to remove the alkaline content. It then went through new clothes. The filtered solution is put on the papers because neem is a natural repellent.

### **Talsi Leaf**

To make the manuscripts more resilient and to keep insects from damaging them, talsi leaves should be placed in between the folios.

### **Marigold Leaf**

By sandwiching the marigold flower petals between the manuscript folios, they serve as preservatives. Marigolds naturally repel insects and provide warmth. Utilising Tobacco Leaves The manuscripts are smeared with a tobacco leaf solution in water. It repels insects as well.

### **Red Cotton Cloth**

Red cotton cloth is a natural worm and insect repellent; thus, manuscripts should always be wrapped in it.

### **Wooden Plank**

A wooden plank that is somewhat larger than manuscripts should always be used to cover manuscripts from both sides. In the event of a fire, it keeps the manuscripts secure and keeps them from suddenly coming into touch with flames. A thick cotton string should be used to secure the wooden planks.

### **Indian worm wood**

Indian worm wood, or naga-damani, contains an essential oil with a pleasant scent and insect-repelling properties that helps remove insects from manuscripts.

### **Mint Leaves**

Ants and cockroaches are also repelled by mint leaves.

### **Black-Cumin**

Black-Cumin (*Kala Jeera*), which repels insects and has a potent aroma. Insects are kept away by scattering the seeds at the document storage.

### **Panadi**

To protect the manuscript bundles from white ants, small bags of a type of grass called Panadi, which is produced in Jaisalmir and used to make perfumes, are positioned among them.

### **Dried Tamakhu**

Dried Tamakhu leaves also shield the manuscripts from insect damage. Usually, the leaves are arranged on the shelves where manuscripts are stored or placed in tiny fabric bags. Insects are kept at bay by the nicotinic acid in the leaves.

### **Coconut leaf juice**

An annual ritual involves applying coconut leaf juice (*Coccinia Indica*), wood charcoal, and turmeric paste with a clean cloth, which is then wiped away to make the leaf resistant to insect and fungal attack.

### **Vermillion**

Vermillion or kumkum fruit powder, which is scarlet in tint, is used in certain repositories as an excellent mosquito repellent.

### **Aswagandha Leaves**

To prevent insects from attacking the manuscripts, dried and powdered Aswagandha leaves are stored in little packages.

### **Ginger**

To protect manuscript bundles from insect damage, bits of dried ginger or Vasambu are stored with them.

### **Lemon-grass oil**

Lemon-grass oil coatings are applied on leaf leaves to fortify them and prevent microorganism growth.

### **Chemical Preservations**

Paper manuscripts can be stored with camphor or naphthalene balls since they are effective against silverfish. Mercuric chloride (HgCl<sub>2</sub>) use is an antiquated technique. The substance is persistent in addition to being extremely toxic. This 5% solution works well against American cockroaches. Ammonium thiocyanate (NH<sub>4</sub>SCN) or potassium thiocyanate (KSCN) are less toxic insecticides. However, iron should be avoided. Inter-leaves of tissue paper impregnated with thymol (CH<sub>3</sub>)<sub>2</sub> CHC<sub>6</sub>H<sub>3</sub>(CH<sub>3</sub>) OH and an insecticide are advised to prevent mold in manuscripts. These days, air conditioning, deep freezing, moisture absorbents, photo copying, microfilming, digital archiving, and fumigation are the main methods used to preserve manuscripts.

### **Lamination**

It is a method of preservation. It protects it from all external threats and gives it enough physical strength to endure a very long time. It is a method for strengthening sensitive documents. It takes less time than traditional methods. It is also cost-effective for large collections. It also protects against damage brought on by environmental contaminants. Lamination is the process of covering each leaf or sheet with polythene foil or cellulose acetate. Chiffon is also used by some for this purpose. These days, the work is done by automated machines. Unique texts and paintings should be laminated to prevent deterioration from pests or weather variations. But according to the experts, lamination has its own drawbacks. The significance of managing manuscripts is well acknowledged in both conventional and contemporary approaches. Additionally, the methods used for it are nearly same. It is simple to take care of manuscripts if the reasons behind their destruction are understood. Manuscripts should not be kept in dark areas. There must be enough light in the area, but the manuscripts shouldn't be exposed to direct sunlight. Artificial light must not generate heat when it is required. The arrangement of shelves should allow for unrestricted airflow. It is necessary to take precautions against fire, such as installing smoke alarms and extinguishers. Tests have demonstrated the fire resistance of Indian paint, which may be mentioned here.

Dust must be strictly regulated. A dusting cloth should be used to clean the shelves and manuscripts on a regular basis. Wiping the dust is necessary to prevent it from spreading. Manuscript bundles' crimson cloth needs to be cleaned on a regular basis. Additionally, the stock room floor needs to be regularly cleaned with a moist cloth. Plans must be created to ensure that each bundle of palm-leaf manuscripts is cleaned, leaf by leaf, at least once every six months. A cloth should be used to wipe each leaf on both sides. It is important to keep in mind that when wiping the leaf, the hand should go from the centre outward rather than back onto the leaf, as this could damage it.

Vacuum cleaners can be used to mechanically clean the manuscripts, paper or palm leaf. If there are any insects, they will have to show themselves through this method. Maintaining cleanliness greatly reduces the threat posed by fungi and insects. The person in control needs to be constantly vigilant. Chemical pesticides could be used to

manage insects such as cockroaches, bookworms, and silverfish.

### **Photostat copy**

This is one of the cheapest methods of preservation. A number of priceless manuscripts that are in delicate condition cannot be used by users. Therefore, Photostat copies of such texts that were delivered to the users without worrying about misuse can be rather useful. The manuscripts may not be able to be preserved forever, no matter how much care is taken. As a result, maintaining the contents becomes essential. Photocopying preserves the contents of manuscripts. Because the original manuscripts are maintained and these photocopies can be utilised for study and references, having copies is also a technique of preservation. This helps ensure the safe preservation of the original documents.

### **Air-conditioning**

Manuscripts last longer when the temperature is kept steady. In India, where there are harsh weather conditions, air conditioning in libraries is crucial. It significantly lessens the issue of dust. Many worms and insects cannot survive in the air-conditioned rooms. However, maintaining the air conditioning throughout the day requires attention. The manuscripts will suffer if the air conditioner is turned off for several hours at a time.

### **Deep-Freezing**

Insects and worms cannot survive in temperatures below freezing. Documents that need to be protected can therefore be stored at freezing temperatures. This procedure is non-toxic because it doesn't utilise insecticides. A properly made deep freezer is used for deep freezing. The books or manuscripts are wrapped tightly inside plastic bags. A trolley that is installed inside the freezer holds these loaded bags. The deep freezer is turned on after the lid is closed. For almost three days, the laden bags are stored inside the chamber. After that, the bags are removed from the freezer and left outside for a few hours to get rid of any dew that may have accumulated on the polythene bags' outside. After that, the manuscripts are removed from the bags and put back where they were originally stored.

### **Moisture Absorbents**

Various kinds of moisture absorbents are used to prevent the manuscripts from becoming wet from moisture. The most important ones are charcoal, silica gel, and anhydrous calcium chloride. Silica gel is the most effective moisture absorbent and is thought to be quite safe. Moisture absorbents are a great way to lower the humidity in manuscript libraries that are not air-conditioned. These absorbents can be positioned throughout the space.

### **Microfilming**

A microfilm camera can be used to microfilm manuscripts, which can then be examined as needed using a microfilm reader. By employing microfilms, it is possible to avoid often handling the original manuscripts. However, it should be noted that the content of the manuscript is harmed by the heat generated during photo copying and microfilming. A certain type of camera is used in this genre of film. It is useful for taking images on a lower scale since materials are captured at a much smaller size. Microfilm can live up to

900 years if stored in a specific envelope in a climate-controlled environment. It also preserves manuscripts and other important materials.

### **Digital Preservation**

The typed lines from the manuscripts can be transferred to CD ROMS, where they can be seen on a computer screen or printed off as needed. For this, scanning-capable computers are used. Paper and palm-leaf manuscripts can be directly scanned using a scanner. Digital archiving, also known as digital preservation, is the process of preserving records in a machine-readable format and organising those resources using an appropriate information retrieval system. The digitalisation process includes text messaging, digital resource management, image processing, scanning, and other procedures, each of which requires a specific piece of software.

1. Software for taking pictures
2. Software for improving images
3. Software for optical character recognition
4. Software for digital libraries

As information technology develops, digitisation promises to both expand access for scholars and researchers and preserve and document original writings. The process of digital preservation requires the best technology available, careful thinking, administrative policy, and procedures.

### **Fumigation**

A specifically designed chamber may be used to fumigate manuscripts that are plagued with insects and mildew. An airtight almirah with wire mesh shelves and glass doors is called a fumigation chamber. Four to five shelves could be positioned at roughly 30 cm intervals if the whole height is roughly 180 cm, leaving additional room below. It is possible to cut a round hole (7.5 cm in diameter) in the centre of the lower cover board and attach a stainless-steel plate to it. The contaminated manuscripts will be placed on the shelves. A glass plate containing Thymol (100-150 gms per cubic metre) is placed on a steel plate. A 60-watt Hoover electric bulb is placed under a steel plate and burns for 4 to 5 hours. Heat causes the chemical to sublimate. The vapours flow through the manuscripts above, destroying the insects. Manuscripts will be preserved in a chamber for two days before cleaning and restoration.

Chemicals may smear carbon inks. Manuscripts should not be fumigated without proper safeguards. Naphthalene (C<sub>10</sub>H<sub>8</sub>) can serve as a fumigant. It's a cheap and widely available insect repellent. For over 40 years, the Oriental Research Institute in Mysore has used Ayurveda oil to maintain the health of palm leaves. Sesame (tila) oil is treated with herbal juice and other insecticides. Smear the oil thinly and evenly over both sides of the palm leaf with a brush. This not only cleans the dirt and makes the letters legible, but also repels insects.

### **Control of Temperature**

Because heat and temperature have an impact on manuscripts, safe manuscript storage conditions should be between 72 and 78 degrees Fahrenheit in order to preserve quality manuscripts. Appropriate Air Circulation: Static air in the stack areas can create pockets of stagnant air that encourage the growth of fungi and insects. Cross-ventilation and air circulation via fans and air circulators are two ways

to ensure proper ventilation in the stack areas. Dust and filth should be kept away from manuscripts. Regular cleaning is necessary. It is important to prevent light from entering storage facilities directly. The manuscripts will be impacted and harmed by direct sunlight. The manuscripts will be harmed by the UV light and may decay chemically.

### **Repairing of Manuscripts**

The manuscripts frequently acquire damage from continuous handling for research and study, even with the utmost caution. Therefore, maintaining manuscripts on a regular basis is one of the things that must be conserved. The torn pieces must be delicately glued. Paper compositions in book form must be evaluated in order to repair broken bindings. The physical upkeep of manuscripts should be prioritised. Each manuscript needs to be given individual attention. Worm-eaten sheets or leaves can also be supported with tissue paper. Any holes or broken leaves can be filled in with blank leaves or hand-made paper sheets cut to the right size. This ensures that the sheets are the same size and stops further mutilation. Manuscripts that have been immersed in water should be dried using a fan. The leaves should be carefully removed and spread out to dry. They should not be dried by the sun or an electric heater. The following list includes some of the plants and their products that have been known to have germicidal and insect-repelling qualities since ancient times:

Numerous types of tools are used in mending manuscripts by hand. The repairing of manuscripts can be done by –

- Dry Brush cleaning
- Application of oils like clove/ neem/ citronella etc.
- Wrapping by cloth
- Use of acid-free boards
- Labelling
- Examination
- Putting insecticidal paper

The manuscripts can be cleaned with a cotton swab or a gentle brush. The manuscripts can be cleaned of dust using a glycerine-water solution. Even after cleaning, the fungus can recur. Therefore, it is crucial to fumigate contaminated records and treat them chemically. Anti-fungus treatment is also necessary for wrapping cloth, coverings, plywood, or wood boards when a fungus infection is suspected.

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