PRESERVATION OF ART OBJECTS ON PAPER USING AROMA OF NATURAL PLANTS AND PLANT PRODUCTS AGAINST BIOLOGICAL ORGANISMS

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Since the prehistoric periods museums, libraries and archives are the repositories of most of the priceless collection including different kinds of art objects on paper. Through the centuries humankind has diligently recorded its efforts to perpetuate the inquisitive spirit, fortify history and culture, and illuminate the paths of future generations. Art objects on paper of different kinds have played a very prominent role in the development of cultures. They have helped not only in preservation of the history and culture of mankind, but also influenced the script, language as well as people's mode of thinking.

The history of preservation of art objects on paper was started about five thousand years ago. According to historical evidences preservation of archival records was attempted for the first time in China since the invention of paper making (105 B.C.).

In case of art objects on paper, preservation can be defined as those activities deployed to slow down or even prevent ongoing deterioration of the collection. It deals with minimizing deteriorating factors and maximizing proper handling and security of the collection.

Preventive care is an ongoing continues process and is the first step of object care supplemented by remedial conservation and restoration treatment. The primary method of controlling biodeterioration of art objects on paper is through prevention. This involves several considerations. Reducing the opportunities and resources for the pest to invade and thrive are the fundamental task of prevention.

The preservation of art objects is gradually becoming more and more technology oriented and gradually shifting from our inherited natural methods to the world of synthetic chemicals by deploying more and more funds, infrastructure etc. The problem of preservation of art objects however still persists. Today a wide variety of chemicals which are relatively drastic and toxic have been used to combat biological attack on cultural heritage. Much reliance on the use of these synthetic chemicals has to some extent crimped the progress of our indigenous traditional ways of protecting our cultural property including art objects on paper. The use of synthetic pesticides causes problems of environmental pollution and other undesirable side effects. The evidence of traditional use of herbs and other natural products effectively in the past against the activity of bio-organisms has been found profusely in the history of preservation of cultural heritage. Some examples of such indigenous methods are still now used in many parts of India, even in some rural areas of West Bengal –

1) Rubbing of turmeric paste on palm leaf and paper manuscripts as turmeric has the insect repellent property.

2) Citronella oil, clove oil, lemon grass oil etc., has been used for regaining flexibility of palm leaf manuscripts. These oils have also the insect repellent property.

3) Manuscripts are kept in puja room and thus they are always subjected to the aroma of oil, sandalwood, incense sticks, flowers which have insect repellent property.

4) Dried neem leaves which have insect repellent property are kept between the folios of manuscripts.

5) As a religious activity Havan is performed in temples where manuscripts are kept by burning number of herbs, the fumes of which have the insect repellent property.

6) Ancient scribers used Harital (Arsenic trisulphate), Tunte (Blue vitriol), Sindur (Mercuric sulphide, Mete Sindur (Lead oxide), Lac dye, Margosa gum etc., for illustrating the manuscripts. All these materials are either insecticides or

The bundles of palm leaf manuscripts are kept in the puja room

The palm leaves are kept inside the kitchen over the furnace where smoke is coming out of the kitchen gets into contact with the leaves

Yellow cloth is used for wrapping of manuscript to avoid insect attack

insect repellents.

7) Colourful geometric designs known as Rangoli in North India and Kolam in South India near the door, corridor and puja room were done in the past. Colours used in these designs especially red ochre have the insect repellent property.

8) A smear of the mixture of mud and cow dung is used to purify and sanitize areas.

9) Manuscripts are kept inside the cane baskets that are given an outer layer of cow dung in order to make the storage insect free.

Natural products which could be used for preservation of art objects on paper are apparently non-toxic to environment as well as human beings. So the viable alternative to the present day hazardous chemicals can be the natural organic substances. Therefore, it is a need of the hour to explore the possibilities of using the plant origin pesticides to preserve our cultural heritage.

Turmeric paste was applied on the folios before writing on manuscript to avoid insect attack

The palm leaf manuscripts are stored inside cane basket that is covered by an outer layer of cow dung in order to make the storage insect free

Insect repellents of plant origin is kept in the storage cabinet

There are some advantages of using indigenous methods for preservation of art objects on paper :

- These are not hazardous for human health.
- These do not have any adverse effect on materials.
- These methods do not require much expertise, equipment and financial assistance.
- Materials used in these methods are more or less available in the context of the surrounding climate.
- Resistance to these compounds are not developed as quickly as with synthetic insecticides.
- Most of these compounds are not very expensive.
- People are familiar with the indigenous materials because they use them in the day to day activities.

There are evidences of thousands of essential oil bearing aromatic plants which can be harnessed as effective insect repellents. Out of 1500 aromatic plants found across the globe, about 1000 of them are found to be flourishing in India, either breeder or in wild state. Their efficacy as insect repellent is proved beyond an iota of doubt.

The main property of natural products of plant origin responsible for eradication of biological organism is the aroma they possess. Essential oil which are complex mixture of natural substances such as ketone, terpen, ester, alcohol, aldehyde are extracted from different plant parts like flowers, leaves, seeds, barks, fruits, roots, rhizomes etc., can be used as pesticides either to repel or kill certain biological organisms. Powdered form of various plant products can also be used for the same purpose. These plant materials enter the body of biological organisms by inhalation, absorption or consumption.

Dried tobacco leaf is kept inside the display showcase as an insect repellent

Following natural products of plant origin have proved the potentiality for protecting different kinds of art objects on paper from biological attack –

Neem (*Margosa*) (*Azadirachta indica A. Juss*) :

The neem tree belongs to the family *Maliaceae*. All parts of this tree like leaves, bark, seeds, fruits, flowers are bitter in taste and have the insecticidal property. Dried neem leaves can be

used as insect repellent. Burning of this dried leaves give off odour that is fatal to insects.

Neem oil extracted from the seeds of the tropical neem tree is active against 400 insect species.

Neem seed oil and leaf extracts can also be used to prevent fungal infestation.

Neem (Margosa)(Azadirachta indica) leaves and flowers

Aswagandha [*Withania somnifera (L.) Dunal*] :

It grows as a stout shrub that belongs to *Solanaceae* family. The main constituents of ashwagandha are alkaloids and steroidal lactones. Dried and powdered leaves of ashwagandha in small pillow packs can be kept inside the display and storage cabinets where art objects on paper are kept as insect repellent.

Aswagandha (Withania somnifera)

Tulsi leaf (*Ocimum Sanctum L.*) :

Tulsi is an erect sweet-scented pubescent herb, belongs to *Lamiaceae* family. Essential oil of tulsi has antibacterial, antifungal and antiviral properties. Besides, dried leaves can be kept between the folios of manuscript, paintings, books, records etc., as insect repellent.

Tulsi (Ocimum sanctum)

Oxalis leaf :

These plants are annual or perennial, belong to *Oxalidaceae* family. Raw leaves are burnt very slowly without producing much flame and the smoke coming out of acts as preservative which makes the art objects on paper free from insect attack more than ten years if smoke is introduced once. This process should be repeated after ten to eleven years.

Oxalis leaf

Pyrethrum (*Chrysanthemum cinerariaefolium*) :

This plant contains several active ingredients that are toxic to insects. To produce insect repellent sticks and coils ground powders from dried pyrethrum flowers or extracts obtained from them are used. Smokes generated due to burning of these sticks or coils are irritating and cause the insects to stop feeding as soon as they encounter a treated area. Pyrethrum also acts as contact poison. It can also be used as insect repellent effectively and forces the insects to come out of their hiding places.

Tobacco (*Nicotiana tabacum L.*) :

Nicotine, the active ingredient of tobacco leaves is a non-persistent contact poison. It is found in the tobacco leaves. The dried tobacco leaves packed in pieces of de-starched, acid free cotton cloths or cloth bags can be kept inside the storage boxes as well as display showcases of art objects on paper act as active insect repellents.

Turmeric (*Curcuma longa L.*) :

Turmeric is commonly known as haldi which is root of perennial shrub belongs to *Zingiberaceae* family. The insect repellent property of turmeric depends on its aroma. Curcumin is the chief constituent of turmeric imparts yellow colour. It has insect repellent property.

Ginger (*Zingiber officinale Roscoe*) :

Ginger roots and stems can be used as pesticides against certain insects and fungal spores. It belongs to *Zingiberaceae* family. The characteristic aroma of ginger on which the pesticidal property depends contains 1 to 3% of volatile oil. This volatile oil is also capable of inhibiting the growth of bacteria in closed chamber.

Sweet flag (*Acorus calamus L.*) :

Sweet flag is commonly known as Ghor bach which is a semi-aquatic perennial herb. It is a plant from the *Acoraceae* family. Dried rhizomes or powder of rhizomes packed inside pieces of starch free, acid free cotton cloth or sachets can be used to repel insects in the repositories having art objects on paper. It can also be used as fungicide.

Sweet basil (*Ocimum basilicum L.*) :

Basil is a tender low-growing herb, belongs to *Lamiaceae* family. The leaves of basil can be used as insecticide. The dried leaves of basil contain 0.20-1% essential oil, can be kept inside the folios or pages of books, manuscripts, records as they act as insect repellent due to their strong, pungent, sweet smell.

Bark of Arjun (*Terminalia arjuna*) :

It is a large size deciduous tree, belongs to the family *Combretaceae*. Its bark contains rotenone which possesses insecticidal and insect-repellent properties. Dried or powdered bark kept in small pillow can be used in storage and display cabinet where different art objects on paper are kept.

Bark of Arjun (Terminalia arjuna)

Sitaphal (*Custard apple*) (*Annona squamosa L.*) :

This plant belongs to *Annonaceae* family. The seeds and leaves of custard apple have the insecticidal properties. So, powdered seeds of custard apple can be used to eradicate insects that thrive on art objects on paper.

Lemon [*Citrus limon (L.) Burm.f.*] :

This plant belongs to *Rutaceae* family. Lemon oil can be used as a non-toxic insecticide treatment.

Black pepper (*Piper nigrum L.*) :

Black pepper is a flowering vine in the family *Piperaceae*. Black pepper is also known as gol mirchi. Powdered fruits of black pepper alone or mixed with other natural plant products kept in cotton cloth or sachet can be used as insect repellent in storage and display showcases where art objects on paper are kept.

Black Pepper (Piper nigrum)

Black cumin (*Nigella sativa L.*) :

This plant belongs to *Ranunculaceae* family. It is also known as kala jira. Powdered black cumin seeds alone or mixed with other natural products such as camphor kept in sachet or pieces of cotton clothes or scattered seeds in the display and storage cabinet of art objects on paper act as active insect repellent.

Black Cumin (Nigella sativa)

Clove [*Syzygium aromaticum (L.) Merrill & Perry*] :

Cloves are the aromatic dried flower buds of a tree in the family Myrtaceae. Clove also contains aromatic volatile oil which has the insect repellent properties. Powdered clove alone or mixed with other natural plant products or clove oil can be used to repel insects that thrive on art objects on paper.

Clove (Syzygium aromaticum)

Garlic (*Allium sativum L.*) :

Garlic is a species in the onion family *Alliaceae*. Garlic exhibits anti-bacterial, anti-fungal and insect repellent properties. Garlic oil kills insect pests. Garlic oil mixed with neem oil acts as very effective insecticide.

Garlic (Allium sativum)

Cinnamon bark (*Cinnamomum zeylanicum*) :

The cinnamon tree belongs to the family *Lauraceae*. Cinnamon bark has the anti-bacterial and anti-fungal properties. Cinnamon leaf oil also possesses anti-fungal property, but it is less sensitive than bark oil. Cinnamon oil mixed with clove oil can be used effectively to check fungal infestation on art objects on paper.

Cinnamon bark (Cinnamomum zeylanicum)

Sandalwood (*Santalum album L.*) :

Sandalwood, also known as chandan is hemiparasitic trees of the Santalaceae family. Sandalwood dust acts as an insect repellent. It also acts as a humidity buffer.

Citronella oil :

Citronella oil is one of the essential oils derived from leaves and stems of dried cultivated grasses - *Cymbopogon nardus* and *Cymbopogon winterianus*, found in Asia, belong to the *Poaceae* family. This oil possesses active insect repellent property. Its effectiveness as an insect repellent can be increased by mixing other volatile repellents with animal fat or oil to reduce the rate of evaporation. Citronella oil has strong antifungal properties.

Camphor :

Camphor is a white crystalline substance, obtained from the tree Cinnamomum camphora which belong to *Dipterocarpacaea* family. Crystalline camphor packed in cotton cloth of sachets can be kept inside the storage as well as the display cabinets where art objects on paper are kept to repel insects.

Eucalyptus oil :

Eucalyptus oil is derived from steam distillation of leaves of Eucalyptus occidentalis Skeels, which belongs to *Myrtaceae* family. The oil imparts an aromatic smell. This oil can be used to check fungal infestation of art objects on paper.

Lemon grass oil :

Lemon grass (*Cymbopogon citratus*) is a tall tropical grass belongs to Poaceae family. The fresh stalks and leaves have a clean lemon like odour. This oil has an antifungal property.

Cashew-nut (Anacardium occidentale)

Cashew-nut oil :

This oil is obtained from the fruits of *Anacardium occidentale L.* belongs to *Anacardiaceae* family. It is brown in colour and has an extremely blistering effect on the skin. This oil can be used as insecticide as well as fungicide also.

Mint (Mentha arvensis)

Mint (*Mentha arvensis L.*) :

Mint is commonly known as pudina belongs to *Lamiaceae* family. The active ingredient of this plant is transpulegol on which its insect repellent property depends.

Mixed natural product :

A mixture of following products in dust form along with 25 grams of camphor can be used as an insect repellent –

Black cumin	-	*1 part*
Sweet flag	-	*1 part*
Clove	-	*1/4 part*
Pepper	-	*1/4 part*
Bark of cinnamon	-	*1 part*

All the above mentioned ingredients are dried in the shade and pulverized separately, one at a time. Each powdered ingredient is then put together and mixed thoroughly. 5 gm of this mixture packed into small sachets can be used in the display and storage cabinets as well as between the bundles, pages or folios of art objects on paper as an insect repellent. The effectiveness of this mixture lasts for six months, after which it has to be replaced with the freshly prepared mixture.

Though our natural products of plant origin are not always sufficient to eradicate biological growth and infestation, they should not be dismissed in favour of other synthetic materials. Application of our traditional preservation methods could be encouraged for the preservation of different art objects on paper as they can be the alternative means to safeguard our heritage for posterity.

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