MICROBIAL DETERIORATION OF PAPER- PAINTING

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ABSTRACT

In present paper eight fungal species were identified as deteriogens for paper paintings and manuscripts for which α - aminoisobutyric acid (AIB) showed inhibitory action preventing growth at hyphal stage. It is fungistatic rather than being fungicidal. Since in 1% α - aminoisobutyric acid solution in water-ethanol mixture, the fungal growth was found absent, it is suggested that α - AIB may be used as an effective biocides for control of microbial growth on paper.

INTRODUCTION

A large portion of our cultural heritage is in the form of illustrated paper-paintings, sketches & drawings on paper etc. these paintings and manuscripts are not life forms, but they are a mark, a symbol of life and in this way they are full of life. If we focus our attention to the environment around, it is full of germs and our paintings do not have any defense system like the alert immune system of our own bodies to fight against these germs.

In case of paper paintings, the support i.e. paper itself is most prone to biological attack (Fig. 1.). Paper is mainly made of cellulose fibers, sizing material (e.g. rosin used with aluminium sulphate), adhesive (various gums and mucilage) and fillers and loadings. It is these fibers of cellulose which make this sheet known as paper suitable for writing (i.e. for holding and absorbing inks & colors) and it is these fibers of cellulose only which are making its viability endangered because of biological attack by micro organisms, insects. The microbial deteriorating agents include bacteria, actinomycetes and fungi.

The two aspects that have been dealt with by the author in the present study are: -

1. Identification of paper fungi.

In case of cellulose attacking fungi there are varieties that need mild treatment as they are affecting only superficially while other varieties need strong measures as they damage the complete texture of paper itself. The treatment to be adopted depends largely on the species of fungus. The identification of fungi has been carried out at the at the mycology department of `Indian Agricultural Research Institute (IARI) in Delhi.

2. Antifungal treatment of paper:

A trial to find a less toxic alternative to the toxic fungicides currently in use for microbial deterioration of paper-paintings.

MATERIALS AND METHODS

Identification of fungi

The process of identification of fungi includes the following steps: -

1. Preparing culture tubes.
2. Sterilizing the incubation chamber.
3. Transferring the spores of microbes from deteriorating paper to the cultural tubes.
4. Making pure cultures.
5. Incubating the culture tubes for growth.
6. Making slides of the fungi grown.
7. Recording the microscopic observations of the slides.
8. Growing and identifying the fungi according to the observed.

Most of the cellulolytic fungi grow best on the potato dextrose agar (PDA) although wart agar, prune juice agar, Dox's medium and other media have also been employed.

The inoculation needle or loop was used under inoculation chamber to transfer microorganisms (from paintings to the culture tube). Following inoculation, the cultures were stored or incubated in an environment suitable for growth in an incubation chamber. Cotton blue stain was used for staining the fungi and their proper identification was carried out.

Treatment procedure

In the preliminary studies, related to selection of less toxic preservative against fungal attack, α - amino-isobutyric acid was found effective as a preservative and curative chemical against certain species of paper infecting fungi. The following procedures was followed:-

1. 5 strips of hand made paper were taken and numbered I, II, III, IV and V.

2. Number I strip was treated with 1% solution of AIB in water.
   No. II strip was treated with 2% solution of AIB in water- ethanol mixture. No III strip was treated with 2% solution of alpha-aminoisobutyric acid in water.
   No.IV strip was treated with 5% solution of alpha-aminoisobutyric acid in water.
   No. V strip was `control' sample and was not treated with any biocide.

3. All the five tubes were then infected with fungal spores of Chaetomium - globosum.

4. Keeping a moist paper on a watch glass and then covering them with inverted watch glass made small humidity chambers. The five infected paper strips were kept one in each of these chambers and sealed temporarily with rubber bands.

5. All the five humidity chambers (with strips) were inspected daily for fungus growth if any and the observations were recorded.

RESULTS AND DISCUSSION

Most of the fungal species found damaging paper in the present study were found belonging to Ascomycota & Deuteromycota. The eight fungal species, which were isolated and identified were:- *Chetomium globosum, Aspergillus flavus, Penicillium sp., Cladosporium cladosporatus, Epicoccum perpurance, Alternaria alternata, Torula sp., Trichoderma herianum.* However, only *Chaetomium globosum* was used as a test organism in the present study.

As a result of this study, α - amino-isobutyric acid has been found to be an effective biocide in low concentrations for control of microbial growth on paper. Studies on *Serpula lacrimans*, a timber dry rot fungus, carried out earlier had shown that the mycelium accumulated AIB, which remained unchanged within the hyphae of the fungus and was not incorporated into protein . The inhibitory effect of AIB is probably due to the fact that it competes with utilizable amino acids for uptake into the mycelium creating an artificial starvation for nitrogen. In an earlier study the effect of α - amino-isobutyric acid on *Chaetomium globosum* has been reported [1]. The results obtained in the present study (Table 1) suggest that AIB can be used as an preservative and curative agent. However, its effectiveness against other species of paper infecting fungi (hitherto not reported in this paper) as a broad spectrum biocide is yet to be established. It has been reported as non-toxic to human beings.

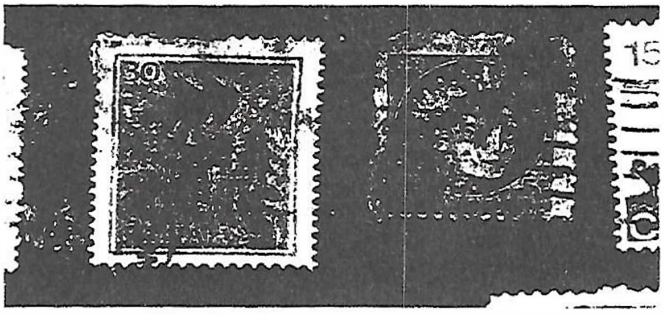

Fig. 1. Fungal growth on paper.

Table 1. Showing effectiveness of Aminoisobutyric acid (AIB) against *Chaetomium globosum* a paper infesting fungi.

STRIPS	I	2	3	4	5
Duration (in Days)	1%AIB in water	1% AIB in water ethanol mixture	2% AIB in water	5% AIB in water	Control
Day 1	+	-	-	-	+
Day 2	++	-	+	-	++
Day 3	++	-	++	-	++
Day 4	++++	-	++++	-	++++
Day 5	++++++	-	++++++	-	++++++

\- Sign indicates the absence of fungal growth.
\+ Sign indicates the extent of fungal growth.

CONCLUSION

From the preliminary studies undertaken using 1 % α -amino isobutyric acid solution in water –ethanol mixture the fungal growth was found absent. Thus AIB was found to be an effective biocide in low concentrations for control of microbial (specifically fungal) growth on paper. This is an important finding as AIB is non-toxic to humans (unlike almost all other fungicides currently in use).

REFERENCES

1. Elliot, M.L., and Watkinson, S.C., 1989. The effect of α-amino isobutyric acid on wood decay and wood spoiling fungi. Int. Biodeterioration, **25** 355-371.

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