

The Science and Technology of Manuscript Writing-aid and Folk Paintings in Medieval Assam[^]

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1 Introduction

The project aimed to study the previously unexplored unique indigenous technologies of medieval Assam, namely, preparation of the traditional writing-aids of *Sancipat*, the writing base; and scaling up of *Mahī*, the herbal ink. It also focused on the methods of painting of manuscripts, artifacts and handicrafts to understand the traditional scientific and technological aspects involved in them and scale-up the technologies for possible tourism marketing. The study involved three components, (i) to study surface-active property, method of preparation and improvement in the properties of *Mahī*, (ii) understanding the traditional method of preparation and preservation of *Sancipat* and improvement in physical and chemical behavior of *Sancipat* (Agaru-bark) at various stages of preparation, physicochemical and biochemical properties such as fluorescence, antifungal etc. (iii) to study the methods of preparation and application of the herbal dyes and mineral pigments for illustration of *Sancipat* manuscript and wooden statues in *Sattras*.

2 Tradition of manuscript writing in Assam

There was a unique and splendid tradition of manuscript writing along with manuscript illustration in Assam on *Sancipat*, a writing base made of tree bark called *Sanci* (*Agaru*, *Aquilaria agallocha*) with *Mahī*, an herbal ink

which started by the 7th century and continued till the early 20th century (Figure 1) (Gait 1906, Kalita, 1990). The tradition was taken to its peak by the Vaishnavite movement in Assam lead by Shrimanta Sankardeva in the 16th century BCE. Tens of thousands of such centuries old manuscripts are still available in Assam. In addition to those in Assam, hundreds of such manuscripts were also found in other adjoining areas like North Bengal and northern Bangladesh. The *Sancipat* manuscripts have tremendous literary values in addition to religious, cultural and historical importance. While paper made of cotton (*tulapat*), cloth, clay, metals like copper, stone, brick, wooden board, bamboo sheet, palm leaves, animal skins, etc., were used as writing base in other parts of the world, *Sancipat* was popular in Assam. The making of *Sancipat* from the bark of *Sanci* (*Agaru*, *Aquilaria agallocha*) tree involved an arduous process involving curing, seasoning and polishing raw slices of bark before it could be made to retain the ink.

The Assamese traditional ink, *Mahī*, which shows no sign of corrosion was prepared from mainly fruit pulp of *Hilikha* (*Terminalia chebula*) and some ingredients of herbal and animal origin with cow-urine as an extractant to facilitate the extraction of the dyes from the plant sources. The indigenous ink, *Mahī*, used for writing also was prepared from locally available herbal ingredients through a unique method not known in any other part of the world. Some other herbal and mineral paints as vermilion (*hengul* in Assamese, *hiṅgula* in Sanskrit), Yellow ochre (*hāitāl* in Assamese, *harītāla* in Sanskrit) together with herbal Indigo (*nīla*) for blue, *kharimātī* or *dhālmātī* for white, Carbon black (*kājala*), Calcium carbonate or sulphate (Chalk) etc which stands out both for the brightness of their hues were also used for painting the manuscripts. The survival of the *Sancipat* manuscripts

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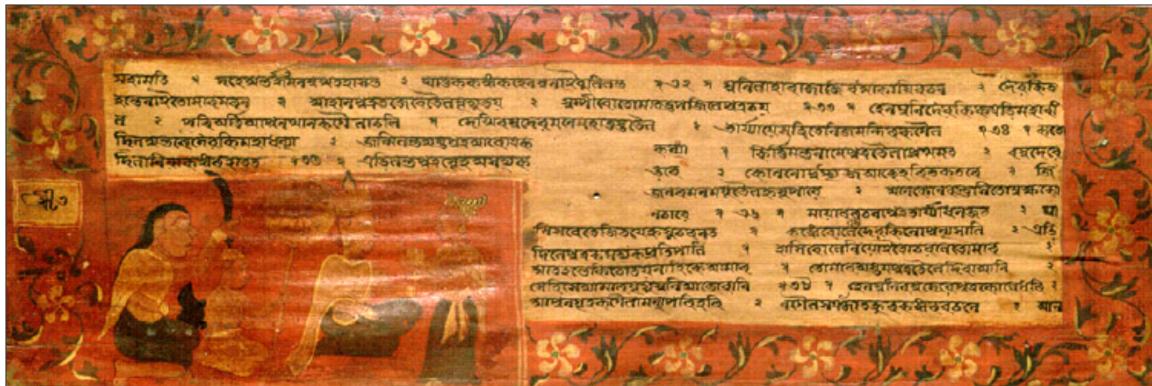


Figure 1 A page from *Adi Dasama*, an illustrated manuscript of *Sancipat* copied in 1799 CE and preserved in Benge-naati Satra, Majuli

for centuries in the hot and humid climate of Assam may also point to possible contributions from *hengul* and *hāitāl* used in the manuscripts. Thus, it is interesting to note the survival of *Sancipat* manuscripts with its allure finish for centuries despite an unfavourable hot and humid climate that incubates fungus and insect which feed on cellulosic materials like *Sancipat*.

Though there are some minor variations in the exact procedures of preparation of *Sancipat*, the principle is essentially the same and involves the major steps, such as acquiring, cleaning, cutting into required size, partial degumming, treatment for paste-resistance, smoothening and finally coating with *hāitāl* and/or *hengul*. The coat of *hāitāl* and *hengul* (cinnabar) may also protect the *Sancipat* from paste and fungus. Two research articles on these has drawn attention of people from different walks of life (Sah 2006, Nath 2015, pp. 207–238, Dutta 2015, 239–261).

Through this project we looked for the possible factors that have helped the *Sancipat* manuscripts to survive over centuries in the harsh climate. For that, we looked at the chemistry of the method of preparation of *Sancipat* and *Mahī*; and the pigments used in preparation of *Sancipat* and in the illustrations in the manuscripts. Some herbal and mineral paints were also used for painting manuscripts, masks used in drama and other traditional artifacts like statues. A plan to study the chemistry of these paints and their application was organized along with the possible health effects of these indigenous techniques with regard to toxicity. These may lead to more interesting findings about the traditional manuscript writing technology, indigenous preservation

methods of early Assam. It may help promote commercialisation of handicrafts production for tourism marketing as it will throw light on dying *Sancipat* making process which once bloomed to full extent as mentioned in Assamese literature. It is worth mentioning that the study of manuscripts or research activities related to the traditional manuscripts are as low as negligible. A systematic study will help us in knowing the traditions which have historical, literary and cultural importance. The proposed work has interdisciplinary relevance involving chemistry, biochemistry, physics, indigenous technology, history, literature and traditional culture and heritage. It would also create public awareness. The work was carried out under the following chapters:

1. Methodologies used for the study
2. Findings and Discussion (i) Scientific study of *Mahī* (ii) Scientific study of *Sancipat* (iii) Reviving the dyeing traditions of *Sancipat* and *hengul-hāitāl*

3 Methodologies used for the study

The methodology involved collection of information available in the literature on preparation and application methods. The information from the few people who are still practicing these methods was collected through field visit and had a hands-on training on the traditional method of manuscript preparation by organizing a small workshop. The detailed methodologies followed for individual objectives are described below:

3.1 Study of surface active property of *Mahī*

The durability of *Mahī* has been considered to be its major attributes that attracts the attention of many historians, curators and traditional practitioners. Surface active property of *Mahī* and the role of biosurfactants as green stabilizer on the chromogenic components of *Mahī* have been studied. The color intensification has been studied through interactions of two representative polyphenols present in *Mahī*, viz., gallic acid and quercetin with iron forming iron-polyphenol complexes, and that of the complexes with surfactants of various charge types (Figure 2).

3.2 Scaling up of preparation of *Mahī*

An attempt has been made to improve the traditional procedure at artificial setting under refrigerator instead of natural setting in cold condition. Here, we have successfully optimized the cold extraction of *Mahī*. As regards, the choice of using analytical grade FeSO_4 (II) as mordanting agent in place of rusted iron nails, to standardize the amount of Fe (II) to get intense black coloured ink, the concentration of Fe (II) was increased ranging from 0–300 ppm and observed that 300 ppm of Fe (II) is optimum concentration for getting instant black color in *Mahī*. Different analytical and spectrophotometric techniques viz.; UV-Vis, FT-IR, Raman, XRD were used to analyze the quality of the ink.

3.3 Study of *Sancipat*, the writing base

The writing base *Sancipat* was prepared by following the traditional method (Figure 3). Variation of ingredients was done to see the effects and contributions of individual ingredients. The physical and chemical behavior of Agaru-bark at various stages of preparation of *Sancipat* was studied by chemical and physical analysis and comparison between a bark and a manuscript paper with respect to various physicochemical parameters including tensile strength (by Universal tensile machine), glossiness (by Glossmeter), etc. The biochemical properties of *Sancipat* was studied by antifungal assay. Another work on the scaling up of preparation of *Sancipat* was done by studying the treatments of *Sancipat* with different herbal and mineral and manipulating the operational parameters like pressing, heating, etc. Value addition to the product was done by optimizing the quality-determining pa-

rameters.

3.4 Study of application of herbal and mineral paints and pigments

The methods of preparation and application of the herbal dyes and mineral pigments along with various natural gums and other additives for painting artifacts and handicrafts were studied. One work on restoration of old wooden sculptures was carried out in the form of workshop. The purpose of these restoration workshops was to carry out practical study and train people in the tradition on along with the restoration of the wearing out centuries-old wooden artefacts.

4 Findings and Discussion

This project work focused on different areas like scientific study of *Mahī*, *Sancipat* and reviving the dyeing traditions of *Sancipat* and *hengul-hāitāl*.

4.1 Scientific Study of *Mahī*

This detailed study on, *Mahī*, presents some interesting physicochemical behavior *vis-à-vis* its possible phytochemical constituents. We have identified some polyphenolic chemicals responsible for the color of *Mahī*. From our recent study, the presence of phenolic acids (Gallic acid and Ellagic acid), four flavonoids (Epigallocatechin gallate, Quercetin, Kaempferol and Epicatechin) and one tannin (Tannic acid) in *Mahī* samples have been confirmed by HPLC analysis. Another observation was that Raman analysis of *Mahī* failed at 514 nm excitation, indicative of increased production of fluorescence of the *Mahī* samples around this region that obscure the Raman signals. The observed fluorescence of *Mahī* has been attributed to the phenolic acids, flavonoids and chlorophyll pigments. UV fluorescence images along with images taken by fluorescence microscope under RFP filter conforms auto-fluorescence of *Mahī*.

In the present study, we have analyzed some physicochemical and biochemical properties of freshly prepared *Mahī* to know the reasons for the glaze and stability of the ink particles for centuries without adding some binder. First, we established a comparison of content determination of total saponins among the mostly used herbal ingredients. After that, we studied the effect of complexation



Figure 2 Preparation of *Mahī* in earthen pot by traditional method and samples in glass and porcelain containers.

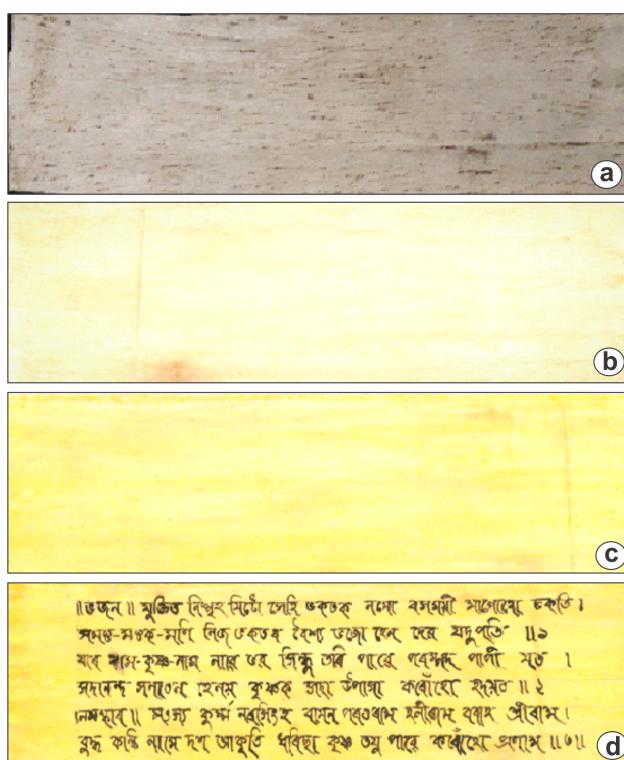


Figure 3 A strip of *Sanci* bark at various stages of traditional method of preparation: (a) after degumming, (b) Manuscript after fatty pulse treatment (c) *Haritāla* applied on *Sancipāt* manuscript and (d) *Sancipāt* manuscript decorated with thin coat of *hengul* on the outer border and inscribed with herbal ink, *Māhi* under supervision of a traditional practitioner.

of both Iron (II)-Gallic acid and Iron (II)-Quercetin complexes in aqueous solution and in micellar solutions of an-

ionic surfactant with emphasis on the UV-Visible spectra and stoichiometry by Job's method of both the complexes. From the study, we observed the effects of anionic surfactant to be the highest. Hence, we can conclude that the presence of glycosides acts as a green stabilizer responsible for the durability of *Mahī* for so many centuries. One research article on 'Role of Biosurfactant in the binding of herbal ink *Mahī*: A view towards green chemistry' is planned.

Again, another attempt was made to improve the traditional procedure at artificial setting under refrigerator instead of natural setting in cold condition. Different analytical tools were applied to study the effectiveness under artificial setting. Raman spectra showed intense peaks at 1590 cm^{-1} , 1352 cm^{-1} and 634 cm^{-1} . Raman measurements on the optimized *Mahī* showed the presence of amorphous carbon (broad bands at 1334 and 1588 cm^{-1}). The broadening of the band at 566 is attributed to the presence of other metallic salts. Powder-XRD analysis confirmed the presence $\text{Fe}_2\text{O}_3 \cdot \text{XH}_2\text{O}$. Also, scanning electron microscopic image of *Mahī* stained on bond paper confirmed that there is no droplet of ink on the surface of bond paper. A full research paper on 'A physicochemical characterization of a medieval herbal ink, *Mahī*, of Assam, India' was published in the journal *Coloration Technology*, 134.6 (2018): 450–463, and two articles *Sancipat, Mahī aru Hengul-Haitalr rasayanic dishto*, and *Mahī – Asomor anupam bheshaj chhinyahi*, in *Sancipatiya puthi* in Assamese have been published in a monograph *Hengul-Haital* in the year 2018.

4.2 Scientific study of *Sancipat*

Some scientific study on preparation of *Sancipat* the writing base made of bark of *Sanci* tree was done by determining certain physicochemical parameters during its processing. *Sanci* tree bark (*Aquilaria agallocha*) grown locally were collected and writing-base using the traditional method were prepared. Various spectroscopic techniques like FT-IR, SEM-EDX, XRD, CHN were applied in the study. Some physicochemical parameters such as tensile strength, gloss index for making a comparison among *Sancipat* folios at different stages of preparation, viz., raw, degummed bark and finished *Sancipat* folio were determined. The antimicrobial study on the *Sanci* bark at different stages of *Sancipat* preparation was done.

From the study, it was observed that both tensile strength and gloss index get increased after undergoing the preparation steps as compared to raw *Sanci*. FT-IR study showed that all the spectra have uniform vibrational frequencies with an exception for the two namely base degummed *Sanci* and *Sancipat*, which shows a medium intensity for -OH stretching frequency (H-bonded). Again, for *Sancipat*, we observed a slight change in intensity for characteristic cellulose peak. In addition to this, from SEM images, we observed a smooth surface for *Sancipat* manuscript as compared to fibre like structure of raw *Sanci*. EDX study showed that the amount of carbon and oxygen slightly higher as compared to raw *Sanci*. XRD study proved the raw *Sanci* to be native cellulose ($C_6H_{12}O_6$)_x. Finally, antimicrobial test showed that raw *Sanci* has no antifungal properties. However, *Sanci* treated with CuSO₄, (*hāitāl*) and *hāitāl* with *hengul* bears the potential of antifungal properties. This antifungal property of treated *Sanci* may be additive or synergistic or cumulative in nature. It is also possible that CuSO₄, (*hāitāl*) and *hāitāl* with *hengul* might be responsible for the antifungal property of *Sancipat* manuscript.

The authors delivered a talk on ‘*Sancipat* manuscript of Assam: revisiting traditional knowledge’ at a national seminar on book history in NE India at Tezpur University during 12–13 February, 2019. A paper on ‘*Sanchipat, Mahī aru Hengul-Haital-ar antarkatha*’, was published in *Sonit Prabha*, mouthpiece of Tezpur Sahitya Sabha in 2019.

4.3 Reviving the dyeing traditions of *Sancipat* and *hengul-hāitāl*

A one-day workshop on ‘the traditions of *Sancipat* manuscript and *hengul-hāitāl*’ was conducted on 11th September 2017 at Tezpur University. Around 30 traditional artisans, practicing the art participated and based on its recommendations, the Government of Assam is considering *Sanci* tree as an agricultural crop, in place of endangered species, which will promote its cultivation and the tradition of *Sancipat* manuscript.

Catalyzed by the present project, we took up and completed a work, during the winter of 2017–2018, involving restoration and renovation, in addition to scientific study, of some antique wood carvings of early nineteenth century at Batadrava Than, Nagaon, Assam, the birthplace of Shrimanta Sankardeva with traditional pigments (Figure 4). In addition to restoration of some precious medieval artifacts in traditional way, a group of 10 persons involved in related activities were also trained to take up such works independently. A similar restoration and renovation of some antique wood carvings in the form of workshops at Boralimora Sattra, Daparbatia, Tezpur was organized. The restoration work received a good media coverage and special praise from public (Figure 5, 6).

5 Conclusion

The scientific study of *Mahī*, revealed that some polyphenolic chemicals are responsible for the color of *Mahī* and some reasons for stability of the glaze of the ink for centuries. The study of the surface active property and the role of biosurfactants as green stabilizer on the chromogenic components of *Mahī* showed glycosides are responsible for its durability. During the scientific study on preparation of *Sancipat*, certain physicochemical parameters were determined during its processing.

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Figure 4 One of the four centuries-old woodcarvings restored at Batadrava Satra, Nagaon (left) and the centuries-old woodcarvings restored at Bor Ali Mora Satra, Tezpur (right).



Figure 5 News clip in Dainik Asom, an Assamese daily on the restoration of woodcarving at Batadrava Than.

The Telegraph, 5th April, 2018

Unique artwork in Xankardeb birthplace

PRANAB KUMAR DAS

Tezpur: Batadrava *than* (shrine) in Bordowa in Assam's Nagaon district, known for being Xankardeb's birthplace, is also known for its exquisite wood carvings that highlight many interesting facets of Vaishnavite movement led by the saint-reformer.

For many scholars such wood carvings are the "finest specimens of the entire range in the subcontinent". However with the passage of time, some of these have faded and need urgent care.

Professor Robin Kumar Dutta, an expert in traditional dyes and pigments, along with Professor Swapna Kumar Dolui, an expert in adhesives and polymers – both from the department of chemical sciences of Tezpur University – with support from the university administration, are busy restoring the centuries-old priceless life-sized wood carvings of *kirtan ghar* of Batadrava *than* to their original look.

They use *hengul* and *hatal*.



The statue of *gadur pakhi* at the shrine in Bordowa.
Picture by Pranab Kumar Das

(vermilion and yellow arsenic) used traditionally in Assam for painting wooden instrument, walls, *mukha silpa* (mask making) and other pigments. Dutta and Dolui were helped by Naren Kalita, an expert in traditional art forms of Assam.

The work, the first of its kind, was also driven by a broader idea of reviving the unique but dying tradition of painted wood carvings with *hengul* and *hatal*. The largest wooden sculpture is a *gadur pakhi*, (a bird found in Hindu mythology) which is about two metres tall and three metres wide. It was painted with *hen-*

gul hatal dated 1833.

There are also another similar but slightly smaller *gadur pakhi* and two wooden sculptures of Hanuman. Though these wood carvings were painted with traditional pigments, all of these have lost sheen with the passage of time. The older *gadur* and Hanuman were later painted with synthetic enamel paints.

Resource persons from various places, including Majuli, Nagaon, Tezpur were involved in cleaning the wood carvings, preparation of paints by grinding and mixing with gum of elephant apple and water, application of paint, application of a final thin coat of natural sap (la charowa) in three phases.

Niran Kotoki and Prabin Bora from Auniati xatra, Majuli, applied the final thin coat of sap on the sculptures after Badal Das and Dewan Singh of Tezpur finished artwork.

Chitta Ranjan Bora, Mridu Mousham Bora from Nagaon joined the traditional artistes from Auniati in painting the sculptures.

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Figure 6 News clip published in *The Telegraph* on the restoration of woodcarving at Batadrava Than.

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