Sāncipāt: a popular manuscript writing base of early Assam, North East India

Asadulla A. Ali, Barsha R. Goswami, Niranjan Ligira and Robin K. Dutta*

Department of Chemical Sciences, Tezpur University, Tezpur 784 028, India

Sāncipāt was a popular manuscript writing base of early and medieval Assam, North East India. Tens of thousands of Sāncipāt manuscripts still exist in the state, some of them centuries old, without fading ink and miniature painting despite its harsh hot and humid climate. Traditionally, Sāncipāt was made from the bark of the Sānci tree using an arduous procedure. In this study, we analysed the physico-chemical properties of the traditionally prepared model and old Sāncipāt folios at different stages of preparation using FT-IR, XRD and SEM-EDX spectra, weight loss during degumming, tensile strength, gloss index and antifungal properties. A comparison of data with freshly prepared Sāncipāt folios showed intact internal structure and strength in the old ones. The antifungal property observed in Sāncipāt is attributed to Tutia used during degumming of the bark, and two pigments, viz., Hengul and Hāitāl applied as thin coating and border respectively. Partial degumming, coating with fatty pulse, application of Hāitāl and Hengul, and repeated pressing, smoothening and drying together impart strength and glossiness to Sāncipāt manuscripts.

Keywords: Antifungal activity, degumming, gloss index, medieval writing base, Sāncipāt manuscripts.

INDIA possesses more than five million ancient manuscripts, making it the largest repository of manuscript wealth in the world[1,2]. These manuscripts are treasures of information for research of Indian intellectual heritage and need adequate conservation[3]. A scientific study of manuscripts and manuscript-making traditions may unravel interesting traditional knowledge and immensely help in their conservation. Different types of writing bases were used in the ancient and medieval world[4–7], such as papyrus in ancient Egypt and medieval Europe, animal skin in medieval Europe and hand-made paper in China. Tālpatra (palm leaf) in South and Southeast Asia and Bhurjapatra (bark of *Betula utilis*, Himalayan birch) in North India. Interestingly, Assam, a state in North East India, had a rich heritage of manuscript writing on a unique type of writing base, viz. Sāncipāt, made from the bark of Sānci tree (*Aquilaria malaccensis* Lamk. syn. *A. agallocha* Roxb.), during the early and medieval periods (Figure 1)[8–10]. Tens of thousands of Sāncipāt manuscripts still exist in Assam, most of them without the fading of herbal ink and lustre for centuries in the harsh and humid climate of the state[11]. The first record of Sāncipāt manuscript is in *Harshacharitam* by Banabhatta, a biography of King Harshavardhana (AD 606–647) of Kanouj, now in North India[12,13]. A bundle of Sāncipāt manuscripts with a reddish-yellow colour of Hāitāl (yellow orpiment) was gifted to Harshavardhana by King Kumar Bhaskaravarman (AD 595–650) of Kamrupa, then Assam. This unique tradition of writing Sāncipāt manuscripts started in the 7th century and continued till the early 20th century[14,15], predominating over other contemporary writing bases like Tulāpāt (hand-made paper) and Tālapatra; but now it is almost extinct[16]. The tradition gained new momentum during the Vaishnavite movement of Assam led by the Vaishnavite saint Srimanta Sankardev during the 15th century, carried forward by the Vaishnavite satras of Assam, and also patronized by the Ahom and Koch kingdom[16,17].

Due to its hot and humid climate, Assam is home to fungi and insects which feed on cellulosic materials. Interestingly, it is a general observation that the survival ability of properly made Sāncipāt manuscripts is greater than that of other types of manuscripts found in Assam, as fungi and insects can easily destroy them. Thus, although the choice of a writing base usually depends on the availability of the material, the unique writing base of Sāncipāt seems to have been chosen due to its greater survival ability over others in the harsh hot and humid climate in addition to the availability of the Sānci tree in Assam[8,17]. The preparation of Sāncipāt writing base from Sānci bark involves repeated smoothening, pressing and drying; partial degumming; polishing with fatty pulse paste; application of yellowish coating with Hāitāl (HgS, cinnabar) and a border with Hengul (As_2S_3, yellow orpiment), and punching a hole at the centre for tying bundles of Sāncipāt folios, which has been reported in several historical and cultural contexts[17,18]. This arduous process of preparation of Sāncipāt through several steps involving some interesting ingredients is considered to be responsible for its special properties, viz. strength, glaze, durability and ability to retain ink and pigment. There are well-researched methods for the conservation of manuscripts made of papyrus[19], paper[20], parchment[21] and Tālpatra[22], but no scientific method is available for the conservation of Sāncipāt, which is different from the other cellulose-based writing bases. Thus, a customized scientific method of conservation is urgently needed to protect tens of thousands of Sāncipāt manuscripts.

*For correspondence. (e-mail: robind@tezu.ernet.in)

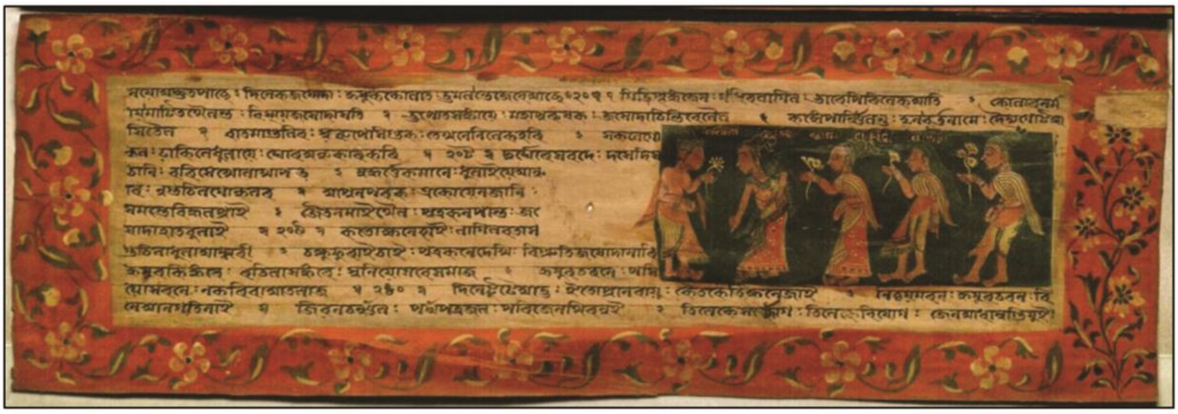

Figure 1. A Sāncipāt folio from *Adi Dasham*, a manuscript dated AD 1799, preserved at Bengena Ati Satra, Majuli, Assam, North East India. The folio is coated with yellow Hāitāl with art on a wide border of Hengul and written with Mahī, a traditional herbal ink of early Assam[8–10]. The illustrations were made with different proportions of Hengul, Hāitāl and indigo.

A scientific study of the traditional knowledge involved in the recipe and the characteristics of Sāncipāt may unravel the secrets of using this unique writing base in preference to others and the secrets behind its survival for centuries with undiminished glaze in an unfavourable climate. The study may also help in a deeper understanding of the craftsmanship and technology that was used, and provide clues for the appropriate method of conservation of Sāncipāt manuscripts. The present study was aimed at carrying out a systematic analysis of the traditional knowledge involved in Sāncipāt manuscripts through the characterization of the folios at various stages of preparation using the traditional recipe and physico-chemical and biochemical analyses with a focus on the possible factors of its survival for centuries retaining the ink and glaze in a hot and humid climate. In order to avoid destructive methods, we prepared a fresh model Sāncipāt by the traditional method under the supervision of one of the few remaining traditional practitioners. We also wanted to find some clues for the customized conservation of Sāncipāt manuscripts.

Experimental technique

Sānci bark was obtained from Debajit Gogoi, Golaghat, Assam, who grows Sānci tree crops for extracting valuable perfume oil from its stem. The Sānci bark strips about 2 m long, 15 cm wide and 3 mm thick were collected from a 17-yr-old tree (Figure 2). The mineral pigments, viz. Hāitāl, Hengul and Tutia (blue vitriol, $CuSO_4 \cdot 5H_2O$) were obtained from Kamakhya Bhandar, Nagaon, Assam (Figure 2). XRD spectra of Hāitāl, Hengul and Tutia revealed them to be As_2S_3, HgS and $CuSO_4 \cdot 5H_2O$ respectively. Potato dextrose broth (PDB) and agar were purchased from Himedia, Mumbai. Distilled water was used to prepare solutions for the degumming process.

Scanning electron micrograph (SEM) and energy dispersive X-ray (EDX) spectra were recorded on a JEOL machine (JSM 6390LV). Fourier transform-infrared (FT-IR) spectra were recorded on a Perkin Elmer spectrophotometer (Frontier MIR FIR). X-ray diffraction (XRD) spectra were recorded on a D8 FOCUS (Software: XRD COMMANDER 2, DIFFRAC.EVA.) spectroscope and PCPDF-WIN software was used to analyse them. Tensile strength was measured using a universal testing machine (Zwick-Z010). The glossiness of the surface was measured with a digital glossmeter (S. C. Dey & Co, Kolkata).

Preparation of Sāncipāt folio by traditional method

The major steps in the traditional method of preparation of a Sāncipāt folio, in brief, involve the removal of a strip of bark several feet in length and several inches width from a mature Sānci tree, drying under sunlight, the strip rolled inside out, smoothening, cutting into size of folios, partial degumming using tutia, drying and smoothening again, application of a primer of a paste fatty pulse and application of a coating of Hāitāl and a border of Hengul before writing[17–19,23]. Sāncipāt folios were prepared in this study under the supervision of a practicing tradition expert as described below. Figure 3 shows the various stages of preparation. The outer scale of the Sānci bark was cleaned using a knife, rolled inside out and dried under sunlight for 10 days. The strip was dampened, cleaned, smoothened and dried again. Then the strips were cut into pieces about 12 inch long and 4 inch wide. These pieces were analysed as raw Sānci bark. The pieces were soaked in 500 ml water in a plastic tray in the presence of 0.1 M Tutia ($CuSO_4$), 10 crushed seeds of Konibih (*Croton triglium*) and 30 g of crushed leaves of Chalkuwari (*Aloe barbadensis*) (Figure 2) for 12 h for partial degumming. These materials were collected locally. Both surfaces of the strip were again scrapped with a small knife and smoothened by rubbing with a Ghila (nicker bean, *Entada scandens* Benth), a hard seed with red colour (Figure 2). Then, a thin coat of fine paste of skinned fatty pulse called Matimah (*Phaseolus radiatus* Linn.) was applied on the strip to fill up any cracks

Figure 2. ***a***, A Bholā Sānci tree after removal of bark. ***b***, Sānci bark strip rolled inside out for drying. ***c***, After degumming. ***d***, After fatty pulse polishing. ***e***, After application of Hāitāl. ***f***, After a drawing border with Hengul and writing with Mahī.

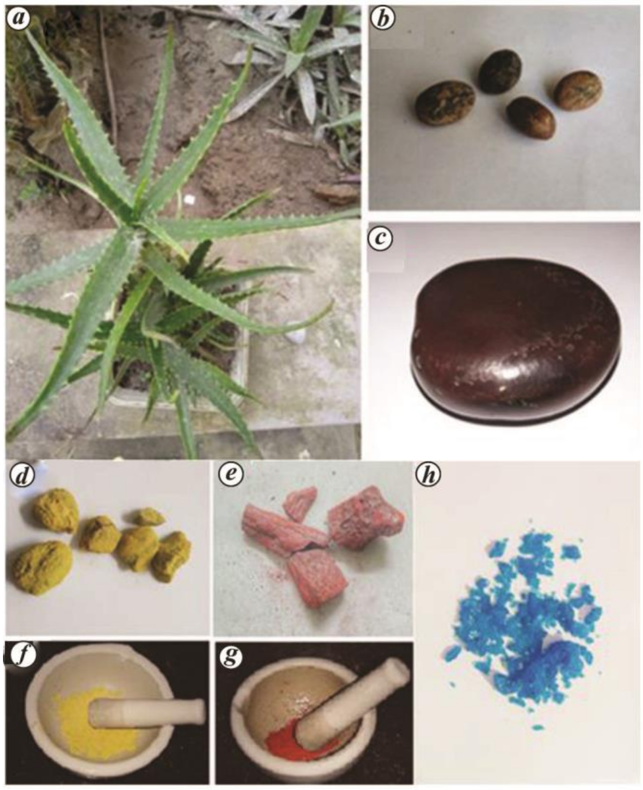

Figure 3. ***a***, Chalkuwari (aloe-vera, *Aloe barbadensis*); ***b***, Koni Bih guti (*Crotton triglium*); ***c***, Ghila; ***d***, pieces of Hāitāl; ***e***, Hengul; ***f***, fine powder of Hāitāl; ***g***, Hengul; ***h***, Tutia.

or wrinkles on the surface and then it was sun-dried. The dry strips were smoothened again by rubbing with Ghila. Then, a thin yellow Hāitāl pigment was applied on both sides of the strip. For this, the paint was prepared by mixing powdered Hāitāl in water using a herbal gum obtained from the fruit of Bel (stone apple, *Aegle marmelos*). The pieces were again sun-dried and smoothened with Ghila. A border of about 1 cm width of red Hengul pigment was applied along the boundaries on both sides of the strip, which was then ready for manuscript writing and illustrations. The freshly prepared Sāncipāt was found to be physically strong, smooth and glazing. The samples were powdered and dried in a desiccator for seven days prior to physico-chemical analysis.

Physico-chemical characterization at various stages of preparation of Sāncipāt folios

In each step of preparation of Sāncipāt from the raw Sānci bark, changes in physical and chemical properties were analysed using various techniques. The effect of smoothening fibrous lignocellulose structure was apparent from the SEM images (Figure 4). EDX analysis showed the atomic percentage of carbon, nitrogen and oxygen in cleaned raw Sānci bark as 44.66, 10.87, 43.15 respectively, commensurate with its lignocellulosic composition[24] (Figure 4). The ratio changed to 54.08%, 10.20% and 34.90% respectively, in freshly prepared Sāncipāt due to the removal of some lignin during degumming, and addition of proteins and fats in the coating of fatty pulse. The atomic percentage of carbon, nitrogen and oxygen obtained for an old, damaged Sāncipāt was 46.69, 8.16 and 44.06 respectively. Mg, Si, S, Cl, K, Ca, As and Pb were detected in trace amounts in all three samples. The amount of arsenic was found to be highest in the freshly prepared Sāncipāt, which could be due to Hāitāl. Cu was absent in the raw Sānci bark but observed in the freshly prepared and the old Sāncipāt samples, which could be attributed to Tutia used during partial degumming.

FT-IR spectra of raw Sānci bark and barks at the three stages of preparation also indicated the presence of lignin,

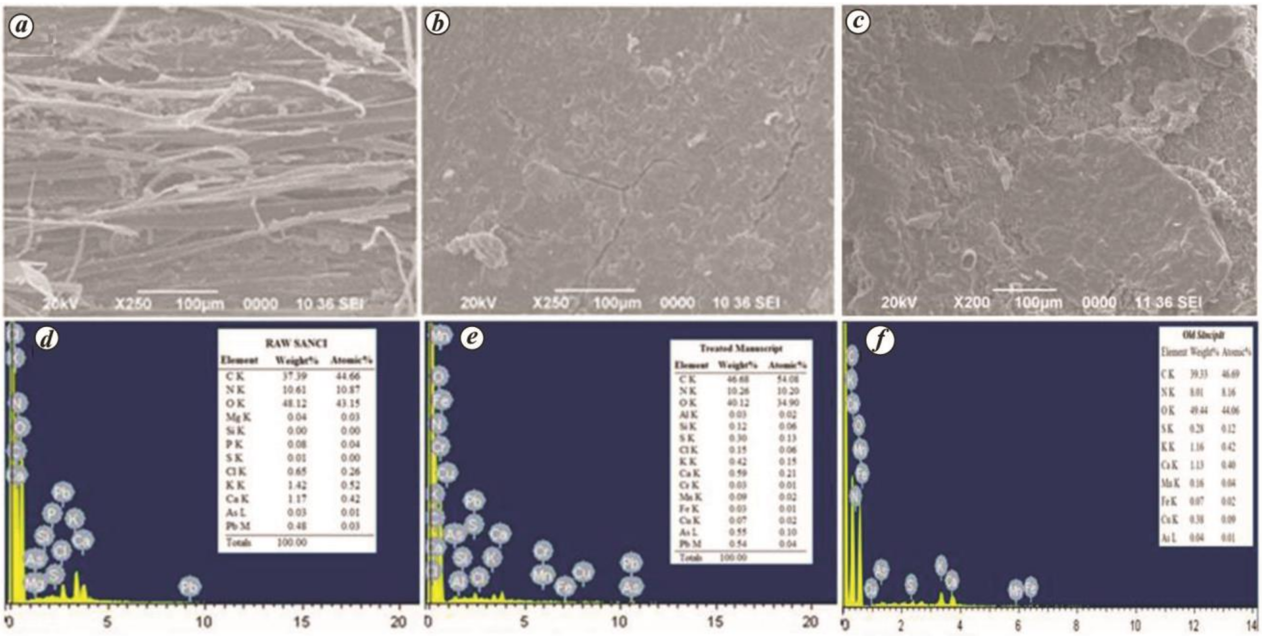

Figure 4. (***a–c***) SEM images of (***a***) raw Sānci bark strip, (***b***) freshly prepared, (***c***) old Sāncipāt manuscript at a resolution of 100 µm. (***d–f***) EDX analysis of (***d***) raw Sānci bark strip, (***e***) freshly prepared, (***f***) old Sāncipāt manuscripts.

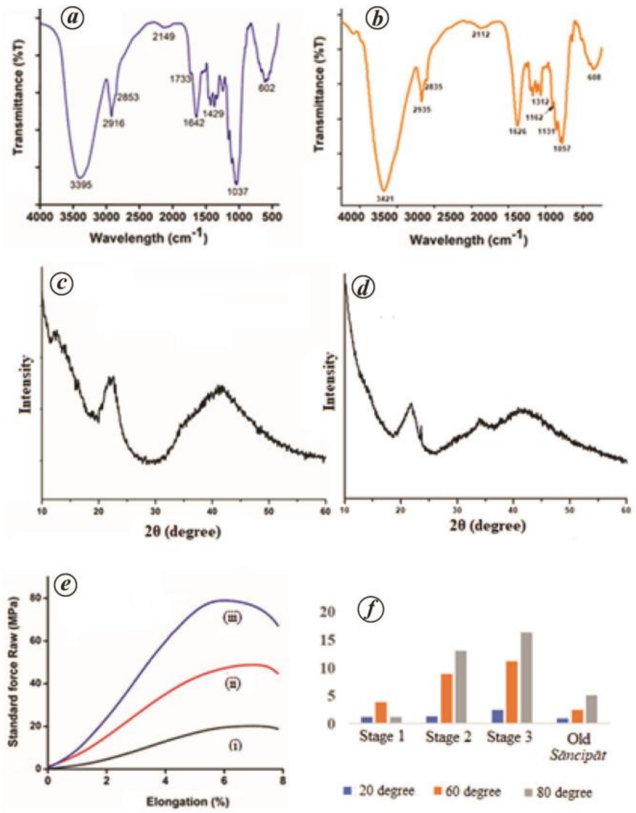

Figure 5. (***a***, ***b***) FT-IR spectra of (***a***) freshly prepared, (***b***) old Sāncipāt manuscripts. (***c***, ***b***) XRD patterns of (***c***) freshly prepared, (***d***) old Sāncipāt manuscripts. (***e***) tensile strength of cleaned raw Sānci bark (i), traditionally degummed *Sānci* bark (ii) and freshly prepared Sāncipāt (iii). (***f***) Average gloss index of Sānci bark at three stages of preparation. Stage 1 – cleaned raw Sānci bark; stage 2 – after application of fatty pulse-paste and stage 3 – freshly prepared Sāncipāt and old Sāncipāt manuscripts measured at 20°, 60° and 80°.

cellulose and hemicellulose (Figure 5). In the traditional method of preparation of Sāncipāt, only a partial degumming is done, retaining the fibrous cellulosic part in order to maintain the basic structure and shape of the bark. As expected, the FT-IR spectra of the old manuscript was also found to be similar to that of the freshly prepared one.

Similar largely amorphous XRD patterns were obtained for both freshly prepared and old Sāncipāt samples (Figure 5). However, characteristic peaks observed at 14.1° (–1 0 1) and 22.8° (0 0 2) and 41.6° (2 4 0)[25], suggest them to be native cellulose, $(C_6H_{12}O_6)_x$, system–monoclinic[21] (PDF no. 030289; ID:03-0289)[25]. A broad peak observed in the range 21.90°–22.80° for freshly prepared Sāncipāt, which was flattened in the old Sāncipāt, may be attributed to a slight change in the cellulose structure.

Figure 6 shows the tensile strength (longitudinal) of cleaned raw Sānci bark, traditionally degummed Sānci bark and freshly prepared Sāncipāt after drying. Elongation at break was the same for all three samples and was approximately 7.8%. The ultimate tensile strength of the cleaned raw Sānci bark increased considerably from 20 to 48 and 78 MPa in the degummed and freshly prepared Sāncipāt samples respectively. The Young's modulus (Y/X) calculated from three points on the three curves at (X = 3.32, Y = 9.97), (X = 3.32, Y = 28.63) and (X = 3.32, Y = 48.01) was found to be 3.00, 8.62 and 14.46 for cleaned raw Sānci bark, degummed Sānci bark and freshly prepared Sāncipāt bark respectively. Thus, the tensile elasticity of the Sānci strip significantly increased during the preparation of Sāncipāt. The degumming and application of a coating of paste of fatty pulse with stone apple gum have probably contributed to the toughness of Sāncipāt.

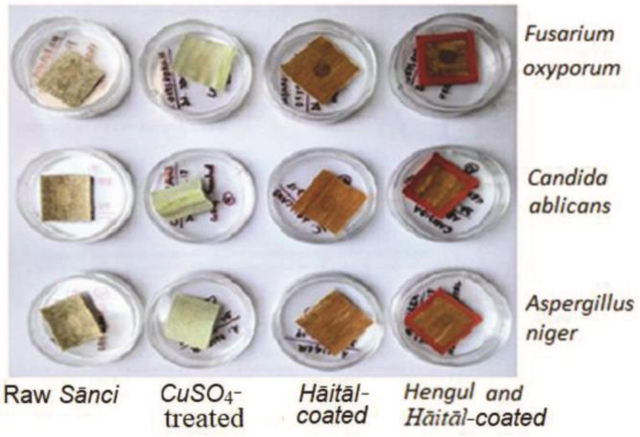

Figure 6. Results of antifungal test with *Fusarium oxyporum*, *Candida ablicans* and *Aspergillus niger* on samples of cleaned raw bark, degumed Sānci bark, and Sānci bark after application of Hāitāl, and and Hengul and Hāitāl.

Figure 6 also shows the average glossiness of the inner side of the folios at the three stages of preparation, along with the average glossiness of three folios of a damaged old manuscript at three different angles of measurements. It has been observed that the glossiness of the folio increased with the angle of measurement, as expected. It was interesting to note a gradually increased glossiness in each stage of preparation. The improvement in gloss index from stage 1 to 3 may be attributed to an increase in reflection due to the filling of the pores and cracks on the surface by the coating of fatty pulse and Hāitāl. However, the glossiness of the old manuscript was much lower than stages 2 and 3 of the fresh ones, as expected. The gloss index of both the inner and outer sides of freshly prepared Sāncipāt was also compared to see if there was any difference between the two sides; they were found to be almost identical (Supplementary Figure 1). Interestingly, it was not possible to distinguish the inner and outer sides of an old manuscript.

The effect of the duration of soaking of Sāncipāt in water in the presence of 0.1M $CuSO_4$ on weight loss or partial degumming of Sāncipāt was analysed by varying the duration up to 24 h (Supplementary Figure 2). The weights were recorded before soaking, and after soaking and drying without scrapping the surface with a knife. There was a linear relation of per cent weight loss with time of soaking (Supplementary Figure 2), calculated as: Final weight of strip/ Initial weight of strip) × 100%. The weight loss may be attributed to a gradual loss of hemicellulose and lignin of the Sānci strip with time during the process.

Antifungal activity

For testing antifungal activity of Sānci bark and Sāncipāt, three filamentous fungi, viz. *Aspergillus niger*, *Candida albicans* and *Fusarium oxysporum* were sub-cultured. A standard procedure was used for antifungal activity test on Sānci strip at four different stages of preparation[26]. The Sāncī manuscript was cut into small pieces of equal surface area for the experiment. For preparation of potato dextrose broth (PDB) solution, 5 g of PDB was dissolved in 50 ml distilled water, followed by autoclaving at 121°C and 15 PSI for 15 min. Moreover, potato dextrose plates were prepared with PDB and 1.8 g of agar. All the fungal strains were seeded to 50 ml of PDA-containing conical flasks and incubated for seven days at approximately 20°C. For the antifungal test, 100 μl of fungal inoculums was spread carefully in the PDA plates and placed them in the incubator. The samples, along with controls, were incubated in a static incubator and their growth was monitored systematically. Water was used as a negative control, whereas antimycotic solution (Himedia) at 10 μg/ml was used as a positive control. All the experiments were performed in triplicates.

Figure 6 shows the results of an antifungal test on samples of cleaned raw Sānci bark, degummed bark, bark after application of Hāitāl, and Sānci bark after application of both Hāitāl and Hengul. The growth of the fungi took place within 48–72 h. Observations of antifungal activity in open control, closed negative control and closed positive control were made after 168 h (Supplementary Figure 3). After 2 h, it was observed that all three fungi grew equally in the open control. *A. niger*, being the most voracious fungus among the three, grew most rapidly in the negative control. On the other hand, *C. albicans* grew most rapidly in the positive control. Fungal growth in the open positive and negative control was observed to increase after one week. There was no fungal growth on any of the samples before incubation. Interestingly, we observed the growth of all three fungi only in the petri plates for cleaned raw Sānci bark after one week of incubation (Supplementary Figure 3). No growth of any of the fungi was observed on the degummed Sānci bark, bark after application of Hāitāl, and Sānci bark after application of both Hāitāl and Hengul.

Fungi feed on cellulosic materials, so Sāncipāt is likely to be damaged by fungi in the hot and humid climate that exists during most of the year in Assam. On the other hand, the three minerals, viz., Tutia, Hāitāl and Hengul, are reported to have antifungal properties[16]. The absence of growth of all three fungi on the samples of degummed Sānci bark, bark after application of Hāitāl, and Sānci bark after application of both Hāitāl and Hengul can be attributed to the antifungal properties of $CuSO_4$ used during degumming of Sānci bark and application of the coating of Hāitāl and Hangul. The antifungal property of Sāncipāt may be additive, synergistic, or cumulative in nature. Interestingly, the present authors have observed in various libraries, museums and personal possessions that Sāncipāt manuscripts with a coating of Hāitāl and Hengul are never destroyed by fungus or insects, while those without these coatings are mostly damaged by fungi or insects (Supplementary Figure 4). It is interesting to note the traditional knowledge of the antifungal properties of these minerals and their use for the protection of Sāncipāt manuscripts from fungus in Assam during the medieval period. Thus, the application of a thin coat of Hāitāl on Sāncipāt manuscripts on the free spaces of the cleaned manuscript folios is a good option for conservation of the manuscripts followed by a thin coating of wood sap traditionally to avoid future contamination during reading. Though Hāitāl is known to be toxic to fungi and insects, it is used in the traditional make-up of Kathakali dancers and for lightening dark skin. However, its prolific use in cosmetics has been reported to pose a risk to human health[27], and care must be taken while handling and applying toxic Hāitāl using gloves and masks.

Conclusion

The present study reveals some interesting traditional knowledge associated with the preparation of Sāncipāt manuscripts related to their attractive appearance, physical properties, composition, adhesion of the ink on them and their longevity under harsh climates. Raw Sānci bark consists of native cellulose along with some hemicellulose and lignin devoid of nitrogenous compounds. The traditional degumming process is less drastic than common alkaline degumming, which partially removes the unwanted hemicellulose and lignin, leaving mostly the fibrous cellulosic part. The amount of carbon and oxygen in freshly prepared Sāncipāt is slightly higher than that of raw Sānci bark. The smoothness of surface, tensile strength and gloss index of Sāncipāt were found to increase during preparation.

The antimicrobial test showed that raw Sānci bark had no antifungal properties, but the bark after degumming in the presence of $CuSO_4$, and after application of a coating of Hāitāl and Hengul showed remarkable inhibition towards fungi. The antifungal property of Sāncipāt manuscripts has been attributed to a synergistic effect of $CuSO_4$ used during degumming and the application of Hāitāl and Hengul. These findings may help in developing a customized method of conserving old Sāncipāt manuscripts.

1. Gaur, R. C. and Chakraborty, M., Preservation and access to Indian manuscripts: a knowledge base of Indian cultural heritage resources for academic libraries. In International Conference on Academic Libraries, New Delhi, 2009, pp. 5–8.
2. Quenzer, J., Bondarev, D. and Sobisch, J.-U., *Manuscript Cultures: Mapping the Field*, De Gruyter, Berlin, 2014.
3. Fleming, B. J., The materiality of South Asian manuscripts from the University of Pennsylvania ms coll. 390 and the Rāmamālā library in Bangladesh. *Manuscr. Stud.*, 2016, **1**, 28–51.
4. Goswami, H., A note on Assamese manuscripts. In *Descriptive Catalogue of Assamese Manuscripts*, Calcutta University, Kolkata, 1930.
5. Banerji, S. C., *A Companion to Sanskrit Literature*, Motilal Banarsidass Publication, 1989.
6. Agrawal, O. P., *Conservation of Manuscripts and Paintings of South-East Asia*, Trubner & Co. Ltd, London, UK, 1984.
7. Fuchs, L. S., Fuchs, D., Hosp, M. K. and Jenkins, J. R., Oral reading fluency as an indicator of reading competence: a theoretical, empirical, and historical analysis. *Sci. Stud. Read.*, 2001, **5**, 239–256.
8. Goswami, B. R., Das, M. K., Das, P. P., Medhi, T., Ramteke, A., Hazarika, S. and Dutta, R. K., Mahi: a unique traditional herbal ink of early Assam. *Curr. Sci.*, 2017, **112**(3), 591–595.
9. Goswami, B. R., Chamuah, N. and Dutta, R. K., A physicochemical characterisation of a medieval herbal ink, Mahī, of Assam, India. *Color. Technol.*, 2018, **134**, 450–463.
10. Goswami, B. R., Das, D., Saikia, P. and Dutta, R. K., Role of saponins on enhancement of quality of *Mahī*, a traditional herbal ink of early Assam. *Dyes Pigm.*, 2021, **188**, 109234.
11. Mazumdar, N. R., Digital preservation of rare manuscripts in Assam. In International Convention on Automation of Libraries in Education and Research, Pondicherry University, Puducherry, 2009.
12. Hermann, K. and Rothermund, D., *A History of India*, Routledge, London, UK, 2004.
13. Cowell, E. B. and Thomas, F. W., *The Harshacharita of Banabhatta*, Royal Asiatic Society, London, UK, 1897.
14. Neog, M., *Early History of the Vaisnava Faith and Movement in Assam*, Motilal Banarsidass, New Delhi, 1965.
15. Datta, B., *Folk Painting in Assam*, Tezpur University, Tezpur, 1998.
16. Nath, D., Religious tradition and social practices in Assam. In *Essays on Popular Religion, Buddhist Tradition and Writing Culture*, DVS Publication, Guwahati, 2015.
17. Dutta, R. K., The science in the traditional manuscript-writing aids of Assam: Sancipat, Mahi and Hengul–Haital. In *Religious Traditions and Social Practices in Assam* (ed. Nath, D.), DVS Publication, Guwahati, pp. 239–261.
18. Sharma, S. K. and Sharma, U., *Discovery of North-East India: Geography, History, Culture, Religion, Politics, Sociology, Science, Education and Economy*, Mittal Publications, Assam, 2015.
19. Roger, B., Papyrus and preservation. *Class. World*, 1998, **91**, 543–552.
20. Ogden, B., On the preservation of books and documents in original form. Commission on Preservation and Access, Washington DC, USA, 1989.
21. Yusopova, M. V., Conservation and restoration of manuscripts and bindings on parchment. *Resturator*, 1980, **4**, 57–70.
22. Suryawanshi, D., Sinha, P. and Agrawal, O., Basic studies on the properties of palm leaf. *Resturator*, 1994, **15**, 65–78.
23. Gait, E. A., *A History of Assam*, Thacker, Spink & Company, London, UK, 1906.
24. McQueen, C. M. A., Mortensen, M. N., Caruso, F., Mantellato, S. and Braovac, S., Oxidative degradation of archaeological wood and the effect of alum, iron and calcium salts. *Herit. Sci.*, 2020, **8**, 1–10.
25. Oreshkina, A., Kaziev, G., Steblevskii, A., Quinones, S. H., Peretokina, O. and De Ita, A., Synthesis and physicochemical study of nonamolybdomanganate with the hexamminecadmium cation. *Russ. J. Inorg. Chem.*, 2013, **58**, 512–514.
26. Bhalodia, N. R. and Shukla, V., Antibacterial and antifungal activities from leaf extracts of *Cassia fistula* l.: an ethnomedicinal plant. *J. Adv. Pharm. Technol. Res.*, 2011, **2**, 104.
27. Mohammed, T., Mohammed, E. and Bascombe, S., The evaluation of total mercury and arsenic in skin bleaching creams commonly used in Trinidad and Tobago and their potential risk to the people of the Caribbean. *J. Public Health Res.*, 2017, **6**, 1097.

ACKNOWLEDGEMENTS. We thank the Indian National Science Academy, New Delhi for a Research Grant (HS/RC568). A.A.A. thanks Tezpur University for an Innovation Research Grant. We also thank Debajit Gogoi and Rupam K. Sharma for gifts of Sānci bark and some Sāncipāt manuscripts respectively, and Harinarayan Konwar for supervising the traditional preparation of Sāncipāt manuscripts/folios.

Received 15 October 2021; revised accepted 30 August 2022

doi: 10.18520/cs/v123/i11/1359-1364