

DEDICATED TO
FATHER & MOTHER
Mr. Sekondor Ali
&
Mrs. Akida Parbin

DECLARATION

The thesis entitled “**A Scientific Study on Sāncipāt Manuscript and Hengul-Hāital Painting Traditions of Early and Medieval Assam**” is being submitted to Tezpur University in partial fulfillment for the award of the degree of Doctor of Philosophy in Chemical Sciences is a record of bonafide research work accomplished by me under the supervision of Prof. Robin K. Dutta.

All help received from various sources has been duly acknowledged.

No part of this thesis has been submitted elsewhere for the award of any degree.

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Place: Tezpur

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CERTIFICATE OF THE PRINCIPAL SUPERVISOR

This is to certify that the thesis entitled “**A Scientific Study on Sāncipāt Manuscript and Hengul-Hāitāl Painting Traditions of Early and Medieval Assam**” submitted to the School of Sciences, Tezpur University in partial fulfillment for the award of the degree of Doctor of Philosophy in Chemical Sciences is a record of research work carried out by **Mr. Asadulla Asraf Ali** under my supervision and guidance.

All helps received from various sources have been duly acknowledged.

No part of this thesis has been submitted elsewhere for award of any degree.

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“Difficulties in your life do not come to destroy you, but to help you realize your hidden potential and power, let difficulties know that you too are difficult”- Dr. A.P.J. Abdul Kalam

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Preface

It is essential to protect national resources and heritage for upcoming generations. The ancient Sāncipāt manuscripts and traditional painting traditions are of important heritage in our country. Sāncipāt manuscripts are treasures of information for research of Indian intellectual heritage and need adequate conservation. A significant medieval tradition of woodcarvings painted with some mineral pigments and natural dyes existed in Assam, India where various types of woods are abundant. In Assam, these mineral pigments and natural dyes gained popularity for use in Sāncipāt manuscript miniature illustrations as well as mural paintings. The tradition became known as Hengul-Hāitāl probably due to their attractive colors or their high cost, though there were some other ingredients too.

This necessitates the establishment of proper scientific research, conservation and restoration methods for century-old woodcarvings and Sāncipāt manuscripts. This thesis describes different physicochemical, biochemical, coloration, and mechanical properties of old and new Sāncipāt folio along with different traditional pigments used in Hengul-Hāitāl painting traditions. Based on our scientific findings we have developed a simplified method of preparation of Sāncipāt without the effect of its original properties and also a customized method is developed for the restoration of old Sāncipāt manuscripts and partially damaged century-old heritage woodcarvings to get their original antique appearance.

A few projects based on our recommended restoration strategy were successfully piloted at the Barduwa Satra in Nagaon, Auniati Satra in Majuli, the Historical Museum at Kaliabor College, and the Boralimora Satra in Tezpur. Thus, the present work brings to light a rich cultural heritage of making woodcarvings with an elegant painting tradition of medieval Assam involving interesting traditional science pertaining to glaze and durability.

This research was carried out in the Department of Chemical Sciences, Tezpur University. I received an institutional fellowship and a research innovation project (grant no. DoRD/RIG/10-73/1544-A) for this research. During the period, I also received financial assistances from two different projects sponsored by the Department of Science and Technology and UNICEF-Assam the form of a junior research fellowship and a research associate, respectively.

Asadulla Asraf Ali

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List of Abbreviations

FTIR	Fourier-transform infrared spectroscopy
p-XRD	Powder X-ray diffraction
DLS	Dynamic light scattering
TGA	Thermogravimetric Analysis
TEM	Transmission electron microscopy
UTM	Universal Testing Machine
CHN	Carbon-hydrogen-nitrogen
DSC	Differential scanning calorimetry
EDX	Energy dispersive X-ray diffraction
PDB	Potato dextrose broth
PVA	Polyvinyl alcohol
THF	Tetrahydrofuran
PCPDFWIN	International Centre for Diffraction Data Powder Diffraction Files database
PDI	Polydispersity index
GPC	Gel permeation chromatography
DTG	Derivative Thermogravimetry
NC	New cellulose
NL	New lignin
OC	Old cellulose
OL	Old lignin
MC	Modified cellulose
ML	Modified lignin

List of Symbols

°C	degree centigrade
%	percentage
L	liter
min	minute
cm	centimeter
h	hour
s	second
K	kelvin
θ	theta
α	alpha
M_n	number average molecular weight
M_w	weight average molecular weight
MPa	mega pascal
μm	micrometer
nm	nanometer
sec	second
J	joule
Pa	pascal
m	meter
mW	milliwatt
Å	angstrom
pH	potential of hydrogen
ml	milliliter
Mol/L	mol per liter
w/v	weight by volume