RESEARCH DISSERTATION

EXTRACTION AND CHARACTERIZATION OF NATURAL PIGMENTS FROM PLANT MATERIALS



SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

BSc.B.Ed (ITEP) CHEMISTRY

6th SEMESTER

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UNDER THE GUIDANCE OF Dr. MANOJ MANDAL

REGIONAL INSTITUTE OF EDUCATION, BHOPAL

2026

DECLARATION

I hereby declare that the dissertation entitled Extraction and Characterization of Natural Pigments from Plant Materials is an original work carried out by me under the guidance and supervision of Dr.Manoj Mandal. The work presented in this dissertation is based on my own study, observations, experimental work, and analysis.

I further declare that this dissertation has not been submitted,either in part or in full, to any other institution or university for the award of any degree, diploma, or certificate.All the sources of information and references used in this work has been duly acknowledged.

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CERTIFICATE

This is to certify that Ms.YASHASWINI SAIN, student of BSc.B.Ed(ITEP) Chemistry, has successfully completed the dissertation entitled Extraction and Characterization of Natural Pigments from Plant Materials under my guidance and supervision.

The work presented in this dissertation is original and has been carried out by the student during the academic session 2025-2026.To the best of my knowledge, the work is satisfactory and fulfills the requirements prescribed for the completion of the dissertation.

Dr. Manoj Mandal
Supervisor

Signature:

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Place:

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to everyone who contributed to the successful completion of my dissertation entitled Extraction and Characterization of Natural Pigments from Plant Materials.

First and foremost, I express my heartfelt gratitude to my research guide Dr.Manoj Mandal, Regional Institute of Education, for providing valuable guidance, encouragement, constructive suggestions, and continuous support throughout the course of this research work.

I am sincerely thankful to the in-charge of the Chemistry section for providing the necessary facilities and academic support required to carry out the experimental work.

I would also like to thank all the faculty members and laboratory staff of Chemistry for their assistance, cooperation, and support during the laboratory work and characterization studies.

I would also like to express my deepest gratitude to my parents, family members, and friends for their constant encouragement, support, and motivation throughout the preparation of this dissertation.

Finally, I thank everyone who directly or indirectly contributed to the successful completion of this research project.

ABSTRACT

Natural pigments are coloured compounds produced by plants and found in flowers, fruits, vegetables, leaves, roots, and rhizomes. They perform important biological functions and have potential applications in food, pharmaceuticals, cosmetics, textiles, and other industries. Due to increasing interest in renewable and natural materials, plant pigments are being studied as alternatives to synthetic colourants.This study focuses on the extraction and characterization of two important natural pigments: anthocyanin and curcumin. Anthocyanins are water-soluble flavonoid pigments responsible for red, pink, purple, violet, and blue colours in many flowers, fruits, and vegetables. Their colour changes with pH, appearing red or pink in acidic conditions and purple or blue in neutral or alkaline conditions. Their stability is affected by pH, temperature, light, oxygen, and storage conditions. Common sources include berries, grapes, red cabbage, purple sweet potato, purple corn, black rice, and coloured flowers.

Curcumin is a yellow-orange polyphenolic pigment obtained mainly from the rhizomes of Curcuma longa (turmeric). It is the principal compound among turmeric curcuminoids, along with demethoxycurcumin and bisdemethoxycurcumin. Curcumin is poorly soluble in water but dissolves better in certain organic solvents. It generally appears yellow under acidic or neutral conditions and may become orange, reddish, or brownish in alkaline conditions. Its colour and stability are influenced by pH, light, temperature, oxygen, and solvent type.

The main aim of this study is to extract anthocyanin and curcumin from selected plant materials and characterize their important physical and chemical properties. The study includes examination of colour, solubility, pH response, thermal stability, and resistance to washing or water exposure. Since anthocyanin and curcumin have different chemical structures and solubility characteristics, different extraction conditions may be required for each pigment.The extraction process involves preparing the plant materials, treating them with suitable solvents, and separating the pigment-containing extracts from solid residues by filtration or other methods. The extracts are then examined through physical and chemical tests. Colour observation provides preliminary information, while solubility studies help indicate the polarity and chemical nature of the pigments. pH testing is especially important for anthocyanin because of its strong colour-changing behaviour, while curcumin also shows noticeable changes under alkaline conditions.

Anthocyanin and curcumin provide a useful comparison of natural pigments. Anthocyanins generally produce red-to-blue shades and are more compatible with aqueous or polar solvents. Curcumin produces yellow-to-orange shades and has limited water solubility. Their differences demonstrate how chemical structure influences colour, solubility, extraction, and stability.The study of these pigments is significant because natural colourants may be useful in food, cosmetics, pharmaceuticals, textiles, and pH-sensitive indicators. Anthocyanin is valuable for its attractive colour range and pH sensitivity, while curcumin is important for its intense yellow-orange colour and natural origin. However, both pigments may be affected by environmental conditions, making stability studies essential.

Overall, this research highlights plant materials as accessible and renewable sources of natural colourants. The extraction and characterization of anthocyanin and curcumin provide basic information about their colour, solubility, pH response, and stability. The findings may support further research on extraction optimization, pigment purification, stability improvement, and practical applications of these natural compounds.

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