The major highlights of this work entitled ‘Evaluation of the mutagenic potential of the commercial textile azo dyes and their biodegradation by Phanerochaete chrysosporium’ are as follows:

1. The mutagenic potential of thirty-two commercial textile dyes, currently being used extensively in northern part of India by leading dye houses like JCT, Phagwara and local dyeing units in Ludhiana, was evaluated by two short-term bacterial tests: Ames and rec. 50% (16 of 32) textile dyes were found mutagenic by Ames test, of which 75% (12 of 16) were direct acting, while 25% (4 of 16) required Aroclor-induced exogenous metabolic activation for mutagenic activity. On the other hand, rec-assay detected 53.1% (17 of 32) dyes to be mutagenic, 52.9% (9 of 17) without metabolic activation and 47.1% (8 of 17) requiring metabolic activation. Together, the two tests detected 79% (22 of 32) commercial textile dyes to be genotoxic. Groupwise, dyes belonging to vat, disperse and naphthol groups were detected mutagenic by both assays, while in addition, Ames detected direct and acidic groups and rec detected sulphur and basic groups as mutagenic. Overall, reactive group was found to be non-mutagenic with either assay.

2. The mutagenic evaluation of nineteen biological dyes/ stains, used very commonly in academic laboratories, by rec assay revealed 58% (11 of 19) dyes to be mutagenic, 73% (8 of 11) of which were direct acting, while 27% (3 of 11) required exogenous metabolic activation to exhibit mutagenic activity.

3. The correlation was worked out between the two short term bacterial assays for concordance of results on mutagenicity of dyes. For commercial textile dyes, 60%; for biological dyes, 86% and for combined textile and biological dyes, 67% correlation was established.
4. The analysis of structure-mutagenic activity relationship for fourteen dyes (with known structures and chromophoric groups) was done. The phenylenediamine moieties in azo groups, presence of amino- and nitro-groups, methylation, CH=CH and chloro/bromo groups were found to be the structural alerts which imparted mutagenicity to the dye compounds. On the other hand deamination, presence of bulkier groups and sulfonation were some of the factors responsible for diminishing/decreasing mutagenicity of dyes. Though the structure-activity relationship for azo, anthraquinone, oxazine and triphenylmethane dyes was established, the same for methine/polymethine dyes could not be ascertained.

5. The optimization of a physicochemical treatment process for dye/dye effluent decolourization, comprising of four sequential physical and chemical parameters i.e. ferrous ions, H$_2$O$_2$, UV and temperature treatment was done. Groupwise, reactive, direct, basic, acidic, napthol and sulphur groups of dyes underwent tremendous decolorization (47–88%) while vat and disperse groups were resistant (<20%) to decolorization. The synthetic effluent lost 74% colour and 75% COD by this optimized physicochemical treatment. The decolorization of monoazo dye -Red GTL- by physicochemical treatment resulted in 82% colour loss and TLC analysis showed formation of a degradation product (R$_f$ value 0.0) as compared to undegraded dye (R$_f$ value: 0.912). When the optimized physicochemical treatment was compared with conventionally used lime treatment process, former gave better decolorization (upto 84% more), no sludge formation and true degradation of dye. When five dyes, mutagenic by rec assay, were subjected to physicochemical treatment and their degradation products were retested for mutagenicity, all products accorded no mutagenicity at equimolar concentrations and required very high concentration to exhibit the same level of mutagenicity as compared to the undegraded control.
6. Three white rot basidiomycetes, along with an algal strain, were screened for their capability to remove colour from a synthetic dye effluent. The results showed that of the three fungal strains, *P. chrysosporium* emerged as the best degrader of dyes amounting to 60% decolorization as compared to *Myrothecium verrucaria* (46.9%) and *Ganoderma lucidum* (37%) while the algal strain *Chlorella vulgaris* led to just 14.6% decolorization.

7. To further improve the efficiency of *P. chrysosporium* for color removal of textile dye effluents, mutations for strain improvement and optimization of medium and growth conditions were carried out. Mutagenesis by UV and NTG led to the selection of ten probable mutants (5 UV treated and 5 NTG treated) on Rose Bengal plates. However, these mutants, when grown in liquid assay, failed to produce any better decolorization of synthetic effluent as compared to wild strain. For optimization of process parameters, modification of original Kirk's medium with respect to buffer, C:N ratio, veratryl alcohol, agitation along with temperature shift, ions, inoculum, oxygen and oil addition led to 54.5% increase in decolorization of synthetic effluent, 4.7-26.3% increase for azo, 56.47-91.28% for anthraquinone, 58.01% for triphenylmethane, 71.81% for oxazine and 58.22-100% for methine/polymethine dyes. Along with increased decolourization, 6.7 fold increase in LiP production and 4-fold increase in biomass was also achieved under improved conditions.

8. Biomass played more role in removal of colour (63%) from synthetic dye effluent, as compared to the enzyme system (38.3%). Also, dead mycelium adsorbed 4% more dyes as compared to live mycelium.

9. The monoazo dye-Red GTL-when was subjected to individual degradation by lignin peroxidase or manganese peroxidase enzymes of *P. chrysosporium* resulted in 39% and 32% degradation respectively. Thin-layer chromatograms of LiP degraded samples showed the formation of one
degradation product while MnP treated samples showed complete degradation of dye along with the production of two degradation products. Mass spectral analysis showed distinctive fragment patterns for undegraded and degraded samples with parent peaks at m/z 302 and 284 for enzyme degraded samples as compared to m/z 332 peak for undegraded dye sample. LiP degraded product, when was evaluated for mutagenicity by rec assay, lost mutagenicity but retained toxicity.

10. Combined physicochemical and biological treatments led to a total of 79% decolorization of synthetic effluent; 74% by physicochemical treatment and further 5% loss by adsorption to fungal mycelium along with 95% COD removal and 87% BOD removal.

11. The efficacy of native soil microflora, *P. chrysosporium* and a microbial consortium (constructed in laboratory from the bacterial isolates) for bioremediation of soil, contaminated with synthetic dye effluent, showed the better role played by fungal inoculum which could degrade 55% of dyes as compared to the other two (~35%). However, combination of fungus with native microflora led to further enhancement in colour reduction to 64.82%. Addition of supplements such as carbon, nitrogen and phosphorous increased the decolorization potential of native microflora as well as microbial consortium by ~32-34% but had no effect on decolorization of dyes by fungal inoculum.

12. In a continuous bed column of *P. chrysosporium*, immobilized on polyurethane foam pieces, synthetic dye effluent (0.5g/l) was decolorized by 89% within a two cycle process.