CHAPTER 6

SUMMARY

The mycotic diversity of leather tannery effluents from four different sites Ambur, Chrompet, Ranipet and Vaniyampadi in Tamil Nadu was studied over a period of one year (April 2011 to March 2012). Leather tannery effluents sampling was carried out at monthly intervals. In addition, studies were carried out to understand the bioadsorption of heavy metal chromium and dye degradation efficiency of the predominant and prevalent fungi present in the leather tannery effluents.

The fungal colonies were identified mostly up to species level. The average CFU/ml, isolation frequency, percentage contribution and monthly variation were calculated and described. Altogether 33 species of fungi belonged to 13 genera were isolated from the leather tannery effluent. These included 2 species of Zygomycotina and 31 species of Deuteromycotina (Mitosporic fungi). From all the collection spots a few non-sporulating colonies were also recorded.

A total of 21 species belonging to 9 genera were isolated along with non-sporulating colonies from the tannery effluent samples collected from Ambur. The major contributors of the population included Aspergillus japonicus, Gliocladium roseum, Aspergillus flavus, A. terreus, Penicillium corylophylum Penicillium citrinum and Penicillium purpurescens. The average CFU/ml of fungi isolated from the leather tannery effluents from Ambur showed that the maximum value (644 CFU/ml) was contributed by Penicillium purpurescens. The frequency occurrence was the highest for Aspergillus flavus as the species recorded 100 percent occurrence in Ambur. The maximum
percentage contribution of fungi isolated from tannery effluent of Ambur was that of *Penicillium purpureascens* (23.79%).

From Chrompet 20 different fungal species were isolated and identified. The population of the fungi isolated from the leather tannery effluent included nine species of *Aspergillus* and four species of *Penicillium* and other genera with single species each. The population density was high for *Aspergillus flavus* (266 CFU/ml), *A. japonicus* (219 CFU/ml), *Penicillium restrictum* (116 CFU/ml), *Aspergillus niger* (94 CFU/ml) and *Penicillium citrinum* (77 CFU/ml). The fungus *Aspergillus niger* occurred in 75% of the samples. *Aspergillus flavus* contributed the maximum percentage to the total (27.75%).

In Ranipet area 16 different fungal species were recorded. The genus *Aspergillus* was represented by six species and *Penicillium* by three species. Other genera were represented by single species each. The fungus, *Paecilomyces variotii* was represented with 411.11 CFU/ml, *Aspergillus flavus* with 277.78 CFU/ml, *Candida albicans* with 108.33 CFU/ml. The species *Aspergillus niger* and *Penicillium funiculosum* were also represented significantly. The frequency occurrence was the maximum for the species *Aspergillus niger* (83.33%) and the maximum percentage contribution was by *Paecilomyces variotii* (34.02) at this collection site.

At Vaniyampadi 16 different species of fungi were isolated and identified which included six species of *Aspergillus* and three species of *Penicillium*. The maximum contributor was *Paecilomyces variotii* with a value of 411.11 CFU/ml. 83.33% of collection was occupied by *Aspergillus niger*. The highest percentage contribution of fungi in the samples at Vaniyampadi was that of *Paecilomyces variotii* (34.42).
The results were subjected to statistical test. The fungal populations recorded during the study period, April’11 to March’12 showed significant variations in their species contribution during different months at 5% level (P<0.005).

On an average *Aspergillus flavus* dominated the other species of fungi with 276.39 CFU/ml. The same species dominated all the other species with its percentage contribution of 21.15% to the total. The fungus, *Aspergillus niger* was recorded in 83.33% of the samplings conducted out of 48 samplings. Among the total 33 species recorded nearly 30% of the species were commonly found in all the four places of study area.

On the basis of percentage contribution and frequency distribution, five predominant and prevalent fungal species, *Aspergillus flavus, A. japonicus, A. niger, Paecilomyces variotii* and *Penicillium citrinum* from the leather tannery effluents were used for chromium adsorption and dye degradation studies.

*Aspergillus flavus, A. japonicus* and *A. niger* have shown their highest percentage adsorption of Cr at pH 4 (94.27%, 93.24% and 88.56% respectively); the adsorption of Cr (VI) increased with increase in pH from 3.0 to 6.0 in general. All the species recorded the minimum values at pH 7. Significant variation was observed in the chromium adsorption efficiency of an individual species of fungus. But between the different species of fungi not much variation was noticed as inferred from ANOVA test.

Experimental results on the adsorption of chromium by the candidate species at varying biomass concentrations showed that different fungal species exhibited different levels of percentage adsorption of the metal at different biomass concentrations. It was also found that the percentage adsorption of chromium increased with increase in biomass quantity to a certain level and
thereafter attained a static level. All the species showed their least adsorption percentage at a biomass concentration of 0.25g. Significant variation was observed both within and between species in the percentage adsorption of chromium by fungal biomass.

The fungi were subjected to varying initial concentrations of chromium for bioadsorption studies. The rate of adsorption of chromium by the fungus *Aspergillus flavus, A. japonicus, Paecilomyces variotii* and *Penicillium citrinum* showed their maximum rate of adsorption of chromium at the initial concentration of 1g/L. In the case of *A. niger* the maximum rate of adsorption (69.71 mg/g) was observed at the concentration of 0.75g/L chromium. The variation in adsorption of chromium by individual species at different initial concentrations of chromium was significant.

Among the fungi studied, the species *Aspergillus japonicus* was found to remove Green MMC at better percentage. The fungus has removed nearly 96% of the dye. This was followed by *A. flavus* and *A. niger*.

Maximum percentage reduction of Navy Blue 5RE was observed with *Aspergillus flavus* (98.56) followed by *A. japonicus* (97.60), *Paecilomyces variotii* (97.28) and *Penicillium citrinum* (95.84). The least percentage reduction of dye Navy Blue 5RE was observed with *Aspergillus niger* (90.56).

The reduction of dye Red PBR was observed the maximum in *Aspergillus niger* (86.58%) and that is followed by *A. japonicus* (83.96%), *A. flavus* (80.52%) and *Paecilomyces variotii* (72.25%). The least percentage reduction of dye Red PBR was observed with *Penicillium citrinum* (39.56%).

The dye Violet 5BN was reduced to the maximum by *Aspergillus japonicus* (98.48%) and that is followed by *A. flavus* (97.37%), *Penicillium*
citrinum (94.17%) and Paecilomyces variotii (92.58%). The least percentage reduction of dye Violet 5BN was observed with Aspergillus niger (90.66%).

Percentage reduction of dye Yellow 4GL was observed maximum with Aspergillus niger (68.24). This is followed by Paecilomyces variotii (67.68), Penicillium citrinum (67.68) and Aspergillus flavus (66.64). The least percentage reduction of dye Yellow 4GL was observed with Aspergillus japonicus (63.67).

The study clearly demonstrated the richness of mycoflora in the leather tannery effluents and their better chromium adsorption and dye degradation efficiency.
6.1 Scope for Future Studies

The present study is a small step towards the future eco-friendly environmental pollution control methods to save our “Mother Earth” from the grip of hazardous pollutants which are accumulating in enormous quantities globally everyday.

- The heavy metal and dye degradation potentials of the isolated species of fungi *Aspergillus* spp., *Paecilomyces variotii* and *Penicillium citrinum* can be made use of in the application for the removal of chromium and dyes from industrial wastewater especially from tanneries.
- Enzyme assay studies can be carried out in the fungal species to find out the chemical nature of heavy metal and dye degradation.
- Based on the assay studies genetic makeup of the organism can be modified to get better results in bioadsorption.
- Desorption studies can be carried out for the management of heavy metal laden biomass as a recovery method and for the cost effective reuse of chromium in the tanneries.
- Since the raw material usage, final products and the environmental impacts vary from tannery to tannery, each unit can be studied separately to find out the appropriate remedial measures for the removal of tannery wastes as an environmental friendly method of disposal.