The study of airborne microorganisms has expanded from the traditional arena of transmission of disease via the respiratory route to include not only human pathogens but also plant pathogens, opportunistic and non-pathogenic organisms, and aerosolized microbial by-products. Air-borne culturable and non-culturable bacteria, saprophytic fungi, free-living parasites, viruses and algae that may result in adverse health effects or environmental impact are now studied within the field of aerobiology. Particles of biological origin are generally referred to as “bioaerosols”. These are ubiquitous in nature and may be modified by human activities. Bioaerosols range in size from submicroscopic particles (<0.01µm) to particles >10 µm in diameter.

Air serves as a mode of transport for the dispersal of bioaerosols from one location to another. The composition and concentration of the microorganisms comprising the bioaerosols vary with source and the dispersal in the air until deposition (Salem and Gardener, 1994). Biologically derived materials are natural components of indoor and outdoor environments. But under certain circumstances, biological agents may be considered contaminants of outdoor. Among the various sources of outdoor air pollution, microorganisms are considered to be the most complex and the least investigated. A wide variety of microorganisms constitutes the airspora of any region and these are dispersed from the source by various agents. The transport and ultimate settling of bioaerosols are affected by its physical properties and the environmental parameters that it encounters while it is airborne. The size, density and shape of the droplets or particles comprise the most important physical characteristics, while the magnitude of air currents, relative humidity and temperature are the significant environmental parameters (Pedley, 1991; Lighthart, 2000). The incidence patterns of airborne particulate matters differ from place to place and season to season.

Environmental factors influence the survival of airborne microorganisms and affect their ability to colonize on surfaces after deposition while harsh environmental conditions tend to decrease the numbers of viable airborne organisms; there is variability in survival between groups of microorganisms and within genera. In general, fungal spores, enteric viruses and amoebic cysts are somewhat resistant to the environmental stresses encountered during transport.
through the air. Bacteria and algae are more susceptible, although bacterial endospores (e.g., *Bacillus spp.*) are quite resistant.

Among different classes of microorganisms, fungi and bacteria have been studied most frequently as risk factors of diseases and other health effects in the work and living environment. Fungi produce large amount of spores, which easily become airborne, thus constituting an important component in microbial aerosols. The external environment is the chief source of fungi found in indoor air and seasonal variations in climatic conditions are therefore responsible not only for variations in the number and types of microbes in outdoor air but also the air indoors. The estimation of airborne microorganisms in indoor air is important for use as an index of cleanliness for any particular environment and to determine the relation they bear on human health (Jaffal *et al.*, 1997). Most naturally occurring bacteria do not cause human illness or other complaints. The risk of illness from environmental bacteria increases only when they enter buildings in inappropriate number or multiply indoors.

In recent years, indoor air quality has become an important issue, because of the occurrence of the “sick building syndrome” and the fact that most people spend more than 80% of their time indoors (NRC, 1981). Indoor fungal contamination depends on numerous factors including moisture, ventilation, temperature, and organic matter present in building materials but so on outdoor fungal load (Medrela – Kudar, 2003). Although indoor environments are considered to be protective, they can become contaminated with particles that present different and sometimes more serious risks than those related to outdoor exposures, when their concentrations exceed recommended maximum limits. These are 1000 *cfu*/m³ for total number of bio-aerosol particles set by the National Institute of Occupational Safety and Health (NIOSH), and by the American Conference of Governmental Industrial Hygienists (ACGIH) with the culturable count for total bacteria not to exceed 500 *cfu* m³ (Cox and Wathes, 1995; Jensen and Schafer, 1998).

Infectious diseases arise from microbes and involve the transmission of an infectious agent from a reservoir to susceptible host through airborne transmission. Various bacterial diseases such as, legionellosis and tuberculosis are linked to cause significant public health concern due to their low infectious dose (Stetzenbach, 2002). *Legionella* become airborne often as a result of active aerosolizing processes (aeration of contaminated water) and may inhabit
various aquatic environments including man-made water systems, often in biofilms in cooling towers, air condition system, etc. The transmission of tubercle bacilli occurs through the inhalation of aerosolized bacilli in droplet nuclei of expectorated sputum from positive tuberculosis patients during coughing, sneezing and talking. The transmission of anthrax bacilli occurs due to inhalation of the spores of *Bacillus anthracis* and outbreaks are often linked to bioterrorism that are spread through intentionally contaminated mail, apart from occupational exposures (Traeger *et al.*, 2002). The airborne transmission of bacterial endotoxins of gram negative bacterial cell wall are potent pyrogens, capable of causing fever in very low concentrations (Parillo, 1993). However, the significance of commonly isolated airborne bacteria in offices, schools, residences, and outdoor environments has not been determined. This is due in part to the isolation of numerous Gram-positive cocci and Gram-negative bacilli in the absence of adverse health effects. Species of *Staphylococcus* and *Micrococcus* are commonly disseminated from nasal and oral surfaces, skin clothing and hair of building occupants. High ratios of the number of air-borne bacteria isolated from indoor air to the number isolated from outdoor air have been used as an indication of high occupancy rate, poor ventilation or inadequate building maintenance.

Since, the population spends about 80% of time indoors, there is considerable concern about the possible effect on health caused by excessive exposure to mould. These effects can be classified as infections, irritations, allergies and toxic effects (Bornehag *et al.*, 2001, 2004).

The health and wellbeing of the public are affected by the physical, chemical and biological properties of the indoor environment. The quality of the indoor environment, however is not easily defined or readily controlled, and can potentially place human occupants at risk. Indoor air contains large numbers of airborne microorganisms. Their estimation is important for use as an index of cleanliness for any particular environment (Williams *et al.*, 1956), and to determine the relation they bear on human health (Jaffal *et al.*, 1997). Knowledge of the incidence of airborne micro flora in houses is important for their possible correlation to infectious diseases or associated allergic reactions (Fink *et al.*, 1971). The concentrations of both spores and their volatile metabolites may become significantly higher in indoor, than in outdoor environments. Since people spend most of their time indoors, they are in continuous contact with the air spores and toxins, and persistent exposure may become significant even if the toxin
concentrations are low. Indoor microbiological pollutions have only recently received attentions, previously afforded to outdoor even indoor chemical pollutions (Yunginger et al., 1976). This is partly due to the broad array of microbial diversity that can evoke human responses, and due to the wide variations in residential, commercial and public buildings (Gammage and Kaye, 1985). Another factor contributing to the lack of concern is the difficulties encountered in sampling biological aerosols and the evaluation of data obtained and identifying related health effects encountered.

Air borne bacteria and fungi can be the cause of a variety of infectious diseases as well as allergic and toxic effects. These microbes have been studied most frequently as risk factors of diseases and other health effects in the work and living environment. Especially fungi produce large amount of spores, which easily become air borne and are able to colonize indoor environments which can utilize nutritional sources and moisture available in indoor materials (Burge, 1992; Flanningan, 1992). Though, indoor spaces with low humidity and characteristic air movements as a result of heating and natural ventilation do not provide favorable conditions for the survival of fungi (Reiss, 1991). In case of sufficient humidity, however, fungi may grow on almost all organic substances. Conditions of above 70% relative humidity may be optimal for fungal growth (Burge, 1985). Although indoor environments are considered to be protective, they can become contaminated with particles that present different and some times more serious risks than those related to outdoor exposures, when their concentration exceeds recommended maximum limits. More than 80 genera of fungi have been associated with symptoms of respiratory tract allergies (Horner et al., 1995). *Alternaria*, *Aspergillus*, *Cladosporium* and *Fusarium* are amongst the most common allergenic genera. Metabolites of fungi are also believed to irritate the respiratory systems.

The fungal spores in both indoor and outdoor environments can be studied quantitatively or qualitatively using samplers. The spectrum of indoor airborne mold spores, such as in homes, offices and other work places, differ from place to place due to the influx of spores from outdoor air through ventilations and air exchangers. Hence, it is difficult to arrive at any significant conclusion on the role of the indoor mold spore in the allergic response. Again, it is not always the quantity but, allergenicity of the mold, which determines the overall development of clinical allergy. Building and behavior related problems in indoor environments may lead to massive
growth of mold with in a very short period of time. In recent years, the increasing incidence of allergy is well recognized not only in the developed but also in the developing countries across the globe. The likelihood that a given individual will develop an allergic disease reflects a combination of genetic and environmental factors.

Association between Immunoglobulin E (IgE) antibodies against molds and occurrence of immediate type I hypersensitivity reaction have been found among residents, and measurement of IgE antibodies as a markers of exposure is recommended in investigations of Type I hypersensitivity reactions (Chowdary et al., 2003 and Portney et al., 2005). Long term surveillance of ambient exposure levels and the monitoring of health impact in occupants by periodic examinations are the best approaches for preventing the occurrence of respiratory diseases and allergies. Preventive modification in the general environment is much more difficult but recent successful efforts to limit cigarette smoking as a passive indoor exposure agent, indicate that the future good health of our citizens mandate such government intervention.

In summary, interest in the populations of airborne microorganisms in agricultural and industrial settings, healthcare facilities, residences, offices and classroom environments has increased in recent years. The potential for adverse environmental and human health effects resulting from indoor and outdoor bioaerosols exposure has prompted renewed interest in aerobiology, and research activity in this area of environmental microbiology has rapidly expanded. Prevention of allergic contact dermatitis is possible only by avoidance or strict barrier protective measures. These recommendations are the only effective means of preventing respiratory diseases because pulmonary disease impairment may be severe and permanently disabling, early intervention and removal from the places mandatory. Symptomatic treatment for respiratory symptoms should only be recommended as a stopgap measure until the exposure is terminated.

In view of the above considerations, the present study was carried out to evaluate the quality of air, breathe whether outdoor or indoor with the following objectives;

- To collect air samples from various microenvironments of extramural and intramural air to analyse and quantify the ambient air quality outdoor and indoor in the selected locations of Chennai city, Tamil Nadu, South India.
- To conduct a regular investigation on the bacterial and fungal counts, percentage distributions of organisms, types of isolates, the current prevalence, seasonal and geographical variations etc., in Chennai, South India and to correlate the outdoor and indoor air quality in terms of bacterial and fungal populations.

- To explore the influence of eco – physical factors such as temperature, relative humidity, rainfall and direction of air current in the microbial distribution of air.

- To screen for the presence of common microbial types, their total counts, percentage distribution and seasonal variations so as to evaluate the relation between the microbial air quality and allergic status of the selected individuals in the sampling sites.

- To study the total immunoglobulin E antibody level as the serological index to relate with the allergic status.

- To evaluate the relationship between the specific immunoglobulin E antibodies against the indoor related microbes as biomarkers of exposure in clinical investigations of allergic reaction.

- To evolve a suitable method to remediate the high risk sites by appropriate air sanitation method and check its efficacy.