



Aeromycoflora in the Central Milk Dairy of Calcutta, India

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Abstract

Intramural aeromycological survey was performed at the Central Milk Dairy, Calcutta, covering eight locations within the Dairy using Burkard personal volumetric air sampler. The locations were butter cold storage (−2 °C), cold store (8 °C), packaging section (23 °C), milk processing section (24 °C), reconstituent of skimmed milk (24 °C), quality control lab (25 °C), raw milk reception (28 °C) and loading dock (26 °C). A number of fungal spores, conidia and mycelia were recorded in different rooms: the highest spore quantity was recorded in the packaging section (23 °C) and the minimum at the butter cold store (−2 °C). The dominant spores consisted of *Aspergillus niger*, *A. flavus*, *Cladosporium* sp., *Fusarium* sp., *Curvularia* sp., *Alternaria* sp., *Torula* sp., *Myrothecium* sp., *Helminthosporium* sp., *Periconia* sp., *Nigrospora* sp. and *Pithomyces* sp.

Introduction

Interest in the research on airborne microorganisms began around the middle of the 19th or 20th century. The knowledge of the composition of airborne spores of a particular area is important in agriculture because crop pathogens can be identified to prevent crop epidemiology and also because some of them act as factors for causing respiratory allergy to susceptible individuals. An allied, but distinctly different role is played by airborne molds in the biodeterioration of stored materials and food stuff.

People spend a major part of their time indoors where they are exposed to harmful pollen grains and fungal spores. Indoor aerobiological researches have been performed all over the world in places such as dwelling houses, poultry sheds and dairies (Raghu and Vittal, 1992; Agashe et al., 1992; Lacey, 1989; Cormier et al., 1991; Santra and Chanda, 1981 etc.; Nandi and Chanda, 1989).

Spores are reproductive entities of lower groups of plants. Fungal spores may remain suspended in the air for quite some time. The characteristic features and

size of the spores determine how deep they may penetrate into the respiratory tract, whereby the exact site of allergic response can be determined. Spores larger than 10 µm diameter are deposited in the nasopharynx causing rhinitis; spores smaller than 5 µm penetrate to the alveoli causing alveolitis. Spores <10 µm size mostly deposit in the bronchi and bronchioles causing asthma (Lacey et al., 1972). After inhalation, the spores release some biochemical reactions which induce the synthesis of specific IgE antibodies causing clinical symptoms of hypersensitivity in the form of respiratory allergic disease.

It is estimated that in India more than 10% of the population is sensitized to fungal spore allergens. Disease expression is affected by the degree of exposure. Repeated exposures to large concentrations of spores, mostly 1–5 µm in diameter, may cause severe symptoms of respiratory allergy.

Generally quite high concentrations of air borne fungal spores are recorded from bakeries, sawmills, poultrys, cowsheds, and dairies. The raw decomposing material, wet environment, garbage, etc. may provide substrates for fungi and produce an

Table 1. Flow chart of central milk dairy, Calcutta.

1. Raw milk reception (28 °C)	Reception of raw liquid milk from various sources.
2. Quality control laboratory (25 °C)	Check of the specific gravity, protein and fat content of the milk.
3. Reconstituent of skimmed milk (24 °C)	Addition of skimmed milk, Butter and Water to the raw milk where necessary.
4. Milk processing section (24 °C)	i) Pasteurization of the milk at 76 °C–4 °C for 15 secs. ii) Homogenization of the fat particles.
5. Packaging section (23 °C)	Packing of pasteurized milk.
6. Cold store (4 °C)	Storing of packed milk at constant temperature of 4 °C for 48 h.
7. Butter cold store (–2 °C)	Storage of butter.
8. Loading dock (26 °C)	Loading of packed milk for distribution.

environment causing different types of respiratory diseases.

The present investigation was conducted to identify the chief constituents of the air spora of different sections of a Milk Dairy in Calcutta under different temperature conditions. It was also intended to find out the correlation between the occurrence of particles of biological origin, especially the pathogenic spores, with disease incidence.

Materials and methods

There are eight sections with varying temperature conditions (–2 °C to 28 °C) in the Central Milk Dairy, Calcutta (Table 1). The eight locations with varying temperature conditions are maintained throughout the year, namely raw milk reception having 28 °C, quality control laboratory having 25 °C, reconstituent of skim milk with 24 °C, milk processing section having 24 °C, packing section with 23 °C, cold store having 4 °C, butter cold store with –2 °C and loading dock with 26 °C. In the first location, i.e. raw milk reception (rms), the raw liquid milk is received from the local supply, and also from different cowsheds. The specific gravity, protein and fat content of the raw milk is checked at the quality control laboratory (qcl). In the reconstituent of skimmed milk section, skimmed milk, butter and water are added to the raw milk when necessary. The milk processing section (mps)

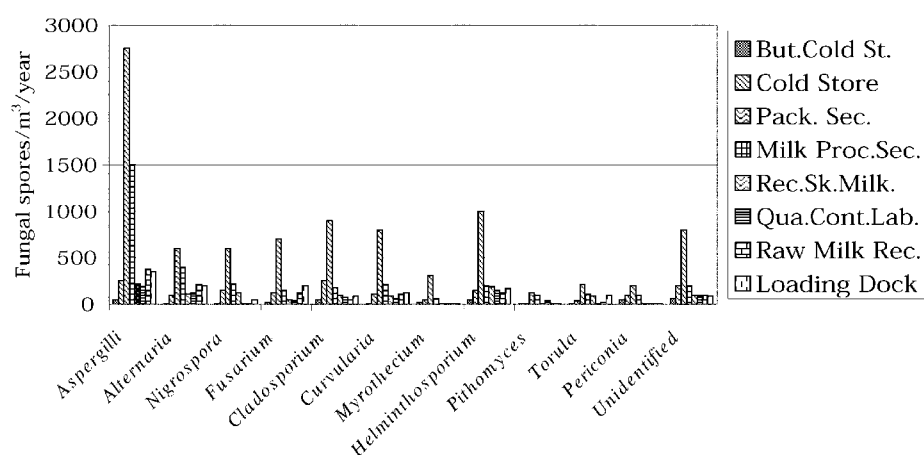
is responsible for pasteurization of milk at 76 °C–4 °C for 15 seconds and subsequent homogenization of the fat particles. The pasteurized milk is packed in polythene bags at the packing section (ps) and then stored at a constant temperature of 4 °C for 48 hours in the cold store (cs) section. After cold treatment, the packed milk is then stored in the butter cold store (bcs) section. Finally, the packed milk is loaded in the milk vans at the loading dock (ld) section for distribution. The intramural air sampling was done in the said eight locations by using Burkard personal volumetric air sampler (Burkard Manufacturing Company Limited, Wooddock Hill Industrial Estate Rickmansworth, Hertfordshire, WD31PJ, England), for one year from May 1997 to June 1998. The Burkard air sampler was placed at one meter above the ground level. The sampler (suction rate 10 Litre/min) was run for 10 minutes twice a day between 7 h to 9 h and 14 h to 18 h at 7 days interval. The counts were converted to concentration m^{-3} of air by multiplying with an appropriate conversion factor (10) as suggested in the guide book of The British Aerobiological Federation (1995). The same sampler was used in different places within the stipulated survey period. Identification of dispersed fungal spores was based on morphological features and with the help of illustrations from Gregory (1973), Nilsson (1983) and also by comparing with reference slides.

Results and discussions

A total of eleven dominant spore types were recorded from the indoor environment of Central Milk Dairy. Some spore types, however, could not be identified. The total number of fungal spores recorded in each location is given in Table 2. Quantitative data of fungal spores of eight locations reflected varying concentration probably based on the varying temperature of different chambers. In butter cold store with –2 °C, a rather low concentration was recorded showing the presence of *Aspergilli*, *Cladosporium*, *Helminthosporium*, *Periconia* etc. The number gained in the cold store at a constant temperature of 4 °C where the dominant spore types were from *Aspergilli*, *Cladosporium*, *Nigrospora*, *Helminthosporium*. The concentration gained a highest value in the packing section where the temperature was 23 °C. Here the spores of *Aspergilli* recorded the highest concentration, followed by *Helminthosporium*, *Cladosporium*, *Curvularia*, *Fusarium*, *Alternaria*, *Nigrospora*,

Table 2. Number of fungal spores per m³ of air recorded over one year in central milk dairy, Calcutta.

Sites	1	2	3	4	5	6	7	8
Spores types	Butter cold store (-2 °C)	Cold store (4 °C)	Packaging section (23 °C)	Milk processing section (24 °C)	Reconstituent skim milk section (24 °C)	Quality control laboratory (25 °C)	Raw milk reception (28 °C)	Loading dock (26 °C)
<i>Aspergilli</i>	50	250	2750	1500	220	190	380	350
<i>Alternaria</i>	10	100	600	400	110	120	210	200
<i>Nigrospora</i>	10	150	600	220	120	10	10	50
<i>Fusarium</i>	20	120	700	150	50	40	120	200
<i>Cladosporium</i>	50	250	900	180	100	80	50	90
<i>Curvularia</i>	10	110	800	210	90	60	110	120
<i>Myrothecium</i>	20	50	310	60	10	10	10	10
<i>Helminthosporium</i>	50	150	1000	200	190	150	120	170
<i>Pithomyces</i>	10	10	120	100	10	40	10	10
<i>Torula</i>	10	40	210	110	90	10	20	100
<i>Periconia</i>	50	100	200	100	10	10	10	10
Unidentified	60	200	800	200	100	100	100	90

Figure 1. Number of fungal spores per m³ of air recorded in central milk dairy, Calcutta.

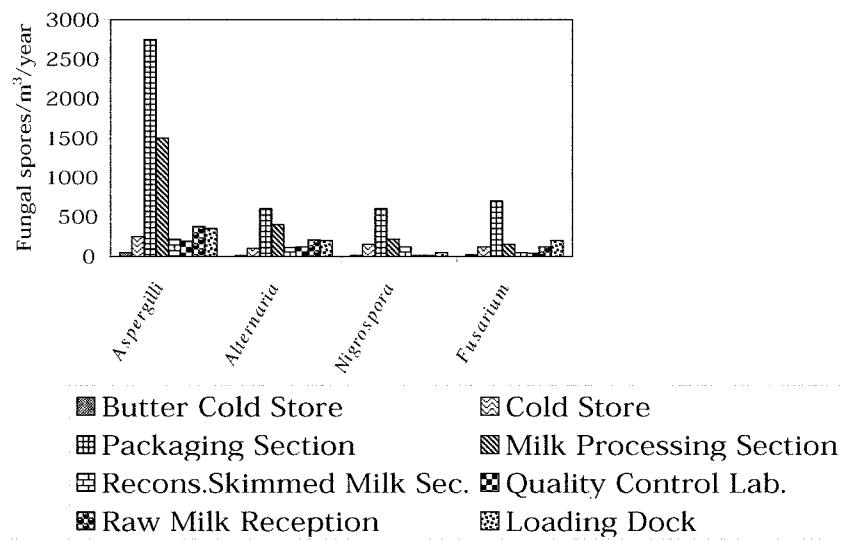


Figure 1a. Number of fungal spores per m³ of air recorded in central milk dairy, Calcutta.

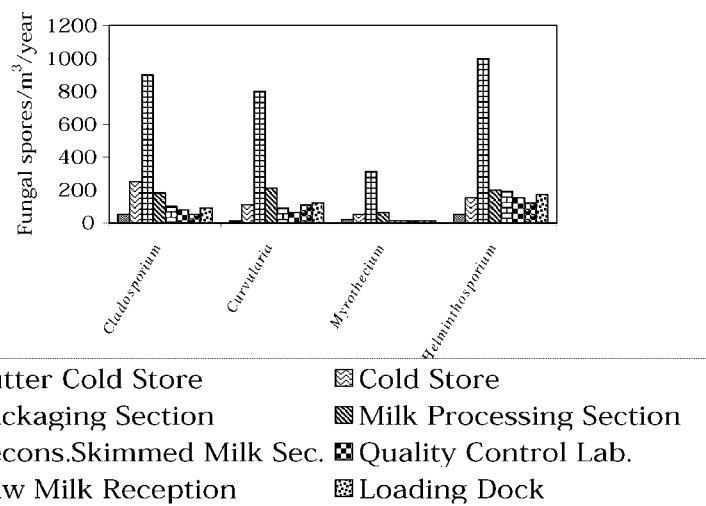


Figure 1b. Number of fungal spores per m³ of air recorded in central milk dairy, Calcutta.

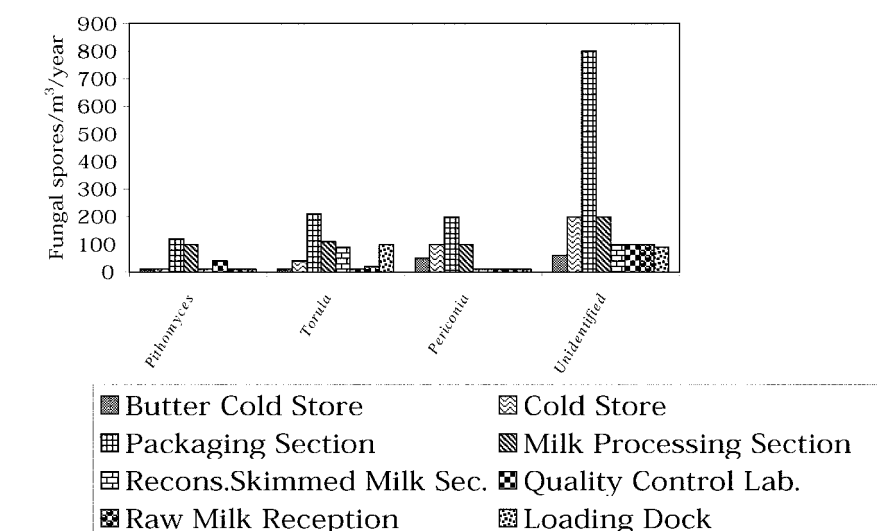


Figure 1c. Number of fungal spores per m³ of air recorded in central milk dairy, Calcutta.

Myrothecium, *Torula*, *Periconia*, and *Pithomyces*. The milk processing section recorded a relatively lower value than the packing section, which may be due to a slightly higher temperature (24 °C). Here the growth of all spores were slightly curbed showing a dominance of *Aspergilli* compared to other spore types. The reconstituent skimmed milk section, having the same temperature as in the milk processing section, showed a drastic reduction in number of spores dominated by *Aspergilli*. Nearly the same result was found in the quality control section and raw milk reception section with a slightly higher temperature. The loading dock section with a temperature of 26 °C, recorded more or less the same concentration of spores. *Aspergilli* recorded maximum concentration in all sections, followed by *Helminthosporium*, *Cladosporium*, *Curvularia*, *Alternaria*, and *Nigrospora*. Spores of *Pithomyces* were recorded only in traces.

In the butter cold store with −2 °C, only a few fungal spores were recorded. The frequency of spores increased with the rise in temperature, namely in the cold store section, packing section and milk processing section.

It is interesting to note that out of the eight sections the highest number of spores were found in the packaging section (23 °C), probably indicating that

the optimum temperature was responsible for higher growth of fungi (Figure 1). High numbers of spores in the packaging section open up the chances of contamination in the processed milk. The high number may also affect the health of employees working in this section. The effects of fungal spores on the workers of the Milk Dairy are still unknown, and should be clinically investigated in its proper perspective.

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