

**REGIONAL AND SPECIAL PROBLEMS**



# MILK HYGIENE PRACTICE IN INDIA

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The concept of "milk hygiene", as it is understood and put into practice in advanced Western countries, is comparatively new to India. Although there has been a general awareness of the importance of cleanliness in the handling of milk, the need for high standards of sanitation during production, the advantages of the storage of milk at low temperatures and the modern techniques of milk hygiene practice have not yet found much application in the country owing to the unorganized state of the milk industry and to other socio-economic causes. The whole structure of Indian dairy industry is, however, changing rapidly, along with the economic and industrial developments that are taking place in the country, and the subject of milk hygiene is bound soon to assume great significance in relation to the successful working of market milk supply projects. The present conditions of milk production and distribution in the country, the special problems of milk hygiene encountered, and the steps being taken to improve the situation are here described.

## Background of the Milk Industry

In order to obtain a proper understanding of the problems of milk hygiene in India, it is necessary to make a brief reference to the climatic and economic conditions under which the dairy industry has been functioning. The Indian Union is situated within the tropical and subtropical zones, and is generally characterized by high atmospheric temperatures during the major part of the year, although there are wide variations from region to region in regard to climate, rainfall, soil and vegetation. The country may be roughly divided into four regions: (1) the great North Indian plains, including the Indo-Gangetic basin, which are characterized by scanty rainfall, a comparatively dry climate and extremes of temperature (varying from 9° to 25°C during winter and from about 28° to 45°C during summer); (2) the Deccan plateau, comprising parts of Central and South India and characterized by hot summers and mild winters; (3) the coastal areas in the north-east,

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south-east and south-west, which have a heavy rainfall and are generally associated with a hot and humid climate throughout the year; and (4) hilly and mountainous regions distributed in various parts of the country and enjoying a temperate climate and good rainfall.

The Indian Union is one of the most densely populated regions in the world as regards both human beings and livestock. There are about 200 million head of cattle and buffalo in the country—about a quarter of the total bovine population of the world—while the human population is over 400 million. Agriculture is the mainstay of the people, 60 %-80 % gaining their livelihood from it. Livestock breeding and dairying, however, constitute only secondary occupations of the cultivators, who keep cattle mainly for draught purposes. With the exception of a few well-defined milch breeds of cattle found in certain parts of the country, the animals used for milk production are of a nondescript type with an average milk yield of less than 2-3 lb. (about 1 kg) a day. A few herds of milch breeds (for example Sahiwal, Red Sindhi and Tharparkar) maintained at government or private farms have been found to be capable of giving good yields of milk (5000 lb. (2300 kg), with a 5 % fat content, per lactation of 300 days), but their proportion to the total population of milch animals in India is very small. Buffaloes, which have a higher milk-yielding capacity than cows and milk richer as regards fat and total solids content, are generally favoured for milk production. The best milch types of cow and buffalo are mostly concentrated in the comparatively dry western and north-western parts of the country, which may be said to constitute the main dairying tracts in India.

Owing to the poor productive capacity of the bulk of Indian cattle, combined with inefficient methods of milk production and handling, the total output of milk is low and falls far short of the requirements of the population. The total annual production of milk in 1951 was estimated at 16.66 million tons (16.92 million metric tons), which increased to 18.87 million tons (19.17 million metric tons) in 1956. Even this amount of milk is not distributed or utilized properly, owing to the scattered production of milk and the difficulties of collecting and transporting it to consumer markets over long distances under tropical conditions. Milk production is concentrated in certain pockets of the country, and during peak seasons there are huge surpluses in these areas which cannot be transported to other parts of the country where there is deficiency of milk. As a result, out of the total amount of milk produced in 1951, only some 36.2 % was used for fluid consumption and the rest was converted into milk products. The average daily *per caput* consumption of milk in India is reported to be about 4.8 oz. (136 g). It is therefore evident that, apart from taking steps to increase the production of milk in the country, it is necessary to reorganize methods of milk production, distribution and utilization on a rational basis and to improve the quality of milk in order to ensure an adequate supply of fluid milk at a cost the population can afford.

### Conditions of the Market Milk Industry

The essential features of the market milk industry in countries where it is well developed can be summed up as follows: (a) hygienic production of milk in large-scale farms situated in rural areas; (b) immediate chilling or cooling of milk; (c) assembling of milk supplies from different farms and their rapid haulage to milk plants in insulated or refrigerated motor vans and road or rail tankers; (d) pasteurization and bottling of milk in the milk plants; (e) distribution of pasteurized milk to the consumers either directly or through consumers' stores; and (f) strict adherence to hygienic practices and enforcement of sanitary regulations at all stages in order to ensure the supply of a safe, clean and wholesome milk to the population. The successful application of milk hygiene in developing the market milk industry in these countries has been greatly facilitated by the organized production and handling of milk on a large scale and the existence of well-developed public health and milk control authorities as well as an educated population conscious of the importance of hygienic quality in milk. In many of these respects the existing conditions in India present a contrasting picture.

The sources of milk production in India may be divided into three categories: village producers, urban producers, and organized dairy farms.

#### *Milk production in villages*

The bulk of the milk (over 90 %) is produced in villages in innumerable and scattered small-scale holdings. The cultivators, whose principal occupations is agriculture, keep a few cows or buffaloes for milk production (2-4 animals on an average) as a supplementary source of income. The average daily milk production per village is estimated to be about 200 lb. (90 kg) (varying from 25 lb. (11 kg) in Assam to nearly 1000 lb. (450 kg) in Delhi State). A major portion of this milk is used for the manufacture of milk products, owing to difficulties of transporting fluid milk from the villages to distant urban markets. The conditions under which the milk is produced in villages are very unsatisfactory, either because of ignorance or because of economic backwardness of the producers. The animals are housed in a part of the living-room or in small closed or open yards adjacent to the house. The flooring is usually of mud without any drainage, and is generally covered with dung, urine and fodder. The animals are rarely washed before milking, but buffaloes get a chance of wallowing in nearby ponds or tanks. The farmers take no precautions at the time of milking: animals are milked by hand after they have been allowed to suckle their calves. All types of utensil, including earthen and brass pots and buckets of odd sizes and shapes, are used for handling the milk. The utensils are not washed properly, either because of ignorance or because of difficulties in procuring sufficient water. The producers try to dispose of their milk as quickly as possible, since there are no facilities for cooling it. Any surplus milk is

boiled immediately and either used for the manufacture of milk products or admixed with the next lot of raw milk at the time of selling. The situation is slowly improving with the expanding opportunities available for marketing village milk in consumption centres, the provision of a good water supply, and the supplying of the producer with suitable types of milk utensil and other facilities. The milk co-operatives, functioning in some parts of the country, have also been trying to improve the conditions of production by providing community milking byres and other facilities.

### *Urban milk production*

The greatest demand for fluid milk as well as for milk products is from the urban centres. It is estimated that more than 3 million tons of milk, or over 50 % of the total amount of fluid milk marketed in India, are consumed by the urban population. Owing to the difficulties of transporting it from rural areas, about 60%-70% of milk supplied to the urban population is produced within the municipal areas, the rest being obtained from nearby villages. This has given rise to the development of a new class of urban milk producers, who generally maintain larger herds (10 animals per producer on an average) than those kept by the village cultivators, and who are exclusively engaged in the business of milk production. The animals are kept in the heart of residential areas under very insanitary conditions with all the attendant handicaps from the point of view of hygienic milk production as well as of public health (see Fig. 1). The need for eliminating these stables from urban centres and moving them to outlying rural areas has been widely realized. This problem has already been partly solved in Bombay city where a separate colony for housing the displaced animals has been established, and arrangements have been made for their maintenance under sanitary conditions and for the collection, processing and distribution of the milk produced in the different units.

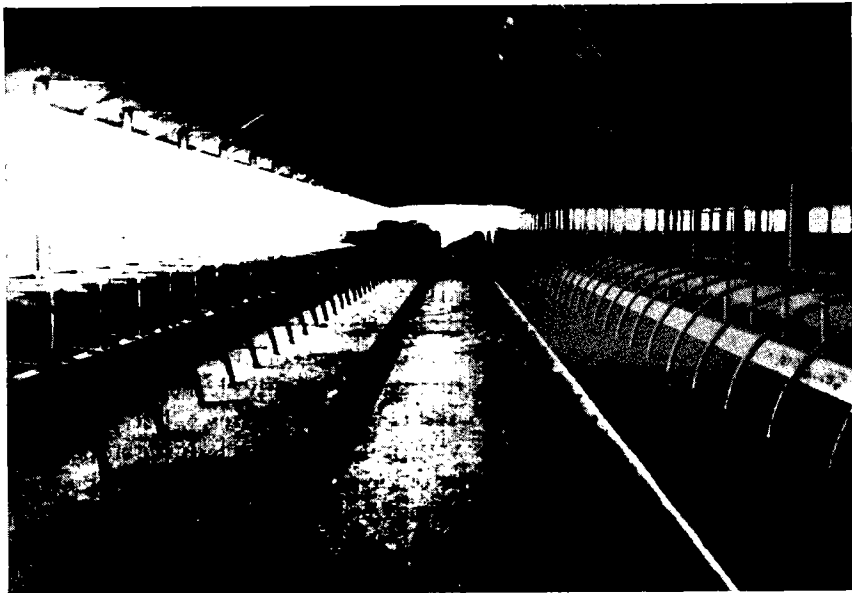
### *Organized farms*

The milk produced in organized farms constitutes only a negligible fraction of market milk in India. There are some 60-70 dairy farms in the country where organized production and handling of milk is possible. These include farms which cater for the requirements of military personnel or are attached to cattle-breeding stations and research or educational institutions. The size of milch herds on the farms varies from less than 100 animals to about 1000 head of cattle and buffalo, while the volume of milk handled ranges from 500 to 5000 lb. (200-2000 kg) a day. Most of the farms are provided with modern cattlesheds, milking byres, fly-proof milk collecting and recording rooms and other amenities required for hygienic milk production (see Fig. 2). Some of them also have pasteurizing and bottling plants, cold-storage facilities, and equipment for the cleaning and sterilization of dairy utensils.

FIG. 1  
A CATTLE STABLE IN THE HEART OF A RESIDENTIAL AREA



FIG. 2  
SANITARY MILKING BYRE IN A MODERN FARM



*Collection, transport and distribution of milk*

The assembling, transport and distribution of fluid milk under the tropical conditions prevailing in India present many difficult problems. As stated earlier, production of milk in villages takes place on a very small scale in numerous scattered holdings, which makes the task of collection difficult. The amount of milk available in most of the villages is so small that even for assembling 5000 lb. (2000 kg) of milk a day a very large number of producers in several villages have to be visited. Many villages are not connected by good roads, and some are inaccessible during the monsoon season. There are no facilities for cooling or refrigeration, and no rapid means of transport. Under these conditions the transport of milk in good condition from villages to the urban markets is quite a difficult task.

There are numerous agencies and persons involved in the collection, transport and distribution of milk—namely, village producers, milk collectors, *halwais* (manufacturers of milk sweets), milk vendors, dairies, producer-retailers, and wholesale or retail markets. The milk collectors, who are the most important links in the chain, visit different villages, collect milk from the petty producers and supply the milk either directly or through bigger agents to the milk collection centres of a dairy, to the *halwais* and milk vendors in the city, or to the consumers. In some cases the producer-retailers themselves deliver milk to the above points. The milk may be carried (in earthen or metal pots or cans) as head-loads, or suspended over shoulder slings, on bicycles, on pack-animals or by horse-drawn tongas, depending on the quantity of milk to be transported and the distances involved. In the case of villages situated at greater distances the milk collectors or agents may transport the milk cans by motor lorry or by rail. In some areas, cans or tins of milk are also transported in small boats.

The containers used for assembling the milk in villages may likewise be earthen or metal vessels of various shapes and sizes, generally without lids. Many of them may be badly dented and rusted, and contain accumulated milk residues and other dirt, so that it is no wonder that the milk thus handled sours very rapidly. In many cases lack of a good water supply in the villages appears to be a major cause for the unclean condition of milk utensils. For long-distance transport of milk, galvanized iron cans (fabricated locally) are generally employed, and where the collection and transport of milk supplies is organized by milk co-operatives or by large dairies (which are, however, very few in number), the cans are usually cleaned and steamed in the dairy and then returned to the collection centres. Use of tinned steel or aluminium milk cans is very much restricted owing to import difficulties as well as to the cost involved.

There are, again, numerous agencies in urban centres that supply raw or pasteurized milk to the population: (a) urban milk producers who deliver milk at the consumers' houses or milk the animals at their doors; (b) rural

producer-retailers who bring milk from nearby villages; (c) *halwai* shops which receive milk from various sources and sell boiled milk kept in open pans; (d) milk vendors; (e) retail and wholesale markets where milk is assembled and sold; and (f) private dairies and co-operative unions. Some of the larger unions and dairies in major cities and towns sell pasteurized and bottled milk.

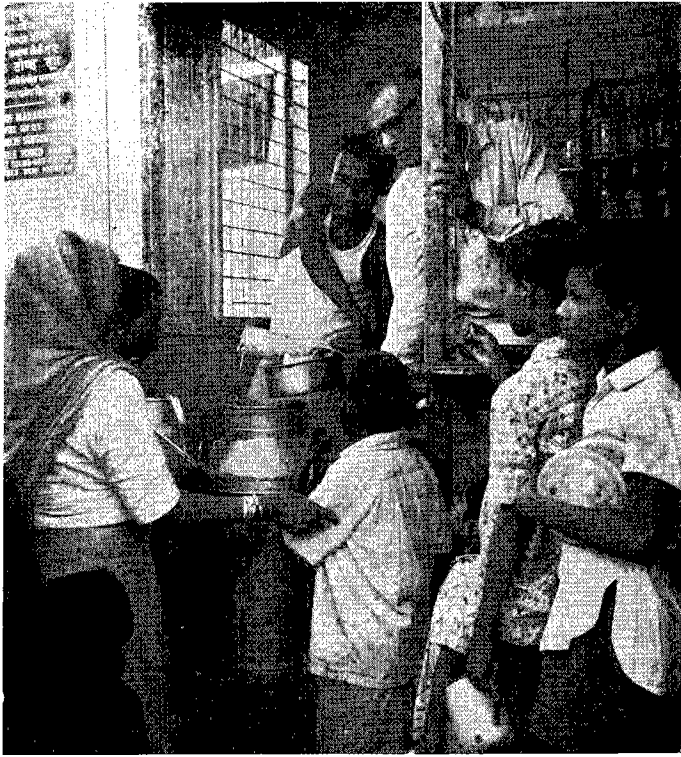
FIG. 3  
DAILY DELIVERY OF BUFFALO MILK IN BRASS CONTAINERS  
TO COLLECTION CENTRE, ANAND



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The question of improving the condition of milk production is therefore closely linked with the problem of urban milk supply. This matter has drawn considerable attention in recent years, and attempts are being made to solve the problem in four directions: (a) organization of co-operative milk producers' societies and milk supply unions; (b) colonization of city milch cattle in nearby rural areas; (c) establishment of organized dairy farms for the production of milk; and (d) establishment of creameries and dairy factories for the utilization of surplus milk in areas producing large

FIG. 4  
SALE OF DOUBLE-TONED MILK AT A GOVERNMENT CENTRE  
FOR UNICEF-SUBSIDIZED MILK, ANAND



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quantities. Co-operative milk supply unions have been organized in several parts of the country and are working very well in solving the twin problems of improving conditions of milk production in the villages and of supplying good-quality milk to the urban population (see Fig. 3, 4). For example, the Kaira District Co-operative Milk Producers' Union at Anand has 138 societies with 40 000 farmer-members affiliated to it, and handles about 24 000 gallons (about 110 000 litres) of milk daily. A major portion of this milk is pasteurized and sent by rail to Bombay in insulated vans over a distance of some 300 miles. Recently, a modern dairy factory equipped for the manufacture of milk powder, casein, baby foods, etc., has been started by this union, with the aid of UNICEF and the Colombo Plan authorities. In regard to the removal of city milch cattle to rural areas, Bombay has taken the lead by establishing the Aarey Milk Colony on the outskirts of the city. The

colony at present maintains 15 000 buffalo owned by private dairymen in modern cattle sheds, and produces about 17 000 gallons (about 80 000 litres) of milk a day, which is pasteurized, bottled and distributed to the city's population. Large-sized projects are also being organized at Calcutta, Delhi and Madras, and 35 other milk supply schemes have been set up under the Second Five-Year Plan. Under the project for organizing the milk supply of Delhi, a modern milk plant capable of handling up to 100 000 gallons (some 455 000 litres) of milk per day is being erected in the capital and is expected to start functioning during 1960. It will supply the population with pasteurized and bottled milk. For assembling the milk and transporting it to the new dairy a number of milk-collecting and -chilling stations are being established around Delhi. In addition, it has also been proposed to establish a large number of milk co-operatives to organize the milk supply of other major cities and towns in India, and to install several milk-products factories in milk-producing areas for the utilization of surplus production.

#### *Processing of milk*

Pasteurization of milk has been universally adopted in Western countries as the most satisfactory method of improving the keeping quality of milk and of ensuring its safety for human consumption. In India, pasteurization plants have been installed in a few large dairies and government farms, but the bulk of market milk is sold in a raw condition. The consumers, however, invariably boil the milk before consumption, and this practice has probably saved them from serious milk-borne infections. Pasteurization of milk for fluid milk distribution has not yet found much application in this country, mainly on account of the scattered methods of production and distribution of milk in small quantities. When the various milk supply schemes in the country come into operation it will become necessary to introduce pasteurization of milk on a wider scale, firstly as a means of increasing the marketable life of milk under tropical conditions, and secondly as a means of ensuring its safety for human consumption. It has, however, been realized that in the absence of adequate facilities for refrigeration and cold storage, pasteurized milk will have to be handled at atmospheric temperatures, which will considerably limit its keeping quality. Investigations carried out at the National Dairy Research Institute, Karnal, have shown that market milk supplies in India generally contain many thermophilic flora and that pasteurized milk undergoes spoilage within 12-20 hours at atmospheric temperatures (30°-37°C) of storage in summer. During the height of summer, when the temperature goes up to 42°-44°C in some areas, the conservation period of pasteurized milk is much shorter. The advantages of adopting more drastic methods of heat-treatment—for example, ultra-high-temperature pasteurization or sterilization—may have to be examined carefully.

### Bacteriological Quality of Market Milk

The effect of insanitary conditions of milk production and handling and the exposure of milk to high atmospheric temperatures during its collection and transport are fully reflected in the poor quality of market milk supplies generally available in the country. This is illustrated in Table 1, where comparative data regarding the bacteriological quality of raw milk produced under different conditions at Centres A and B are presented. Centre A is in South India, which has a fairly temperate climate, while centre B represents a typical North Indian town, characterized by extremes of temperature.

TABLE 1  
BACTERIOLOGICAL QUALITY OF RAW MILK PRODUCED  
UNDER DIFFERENT CONDITIONS IN INDIA (AVERAGE DATA FOR 200-300 SAMPLES  
IN EACH CATEGORY)

Source of milk sample	Age of milk from time of production (hours)	Centre A			Centre B		
		Standard plate counts (thousands per ml)					
		Winter	Summer	Monsoon	Winter	Summer	Monsoon
Organized farm (bulk milk)	2	104	168	177	404	910	990
Village production	2	343	584	467	738	2 621	1 100
Private dairies	4-5	3 408	3 677	1 472	185	9 795	14 300
Milk vendors in urban market	4-5	1 592	1 991	3 750	1 212	6 657	2 460

Centre A: Mean atmospheric temperature 15°-28°C in winter, 22°-35°C in summer, and 20°-32°C in monsoon.

Centre B: Mean atmospheric temperature 9°-25°C in winter, 28°-45°C in summer, and 23°-40°C in monsoon.

It may be seen that the quality of milk samples obtained at Centre B was generally of a lower standard than that of the corresponding category in Centre A, possibly because of the influence of higher atmospheric temperatures prevailing during a major part of the year in the latter region. In both centres the samples of milk obtained from private dairies, which receive milk supplies from a variety of sources, are of the lowest quality.

The different conditions of production and handling associated with the above sources of market milk supply have been described in the preceding paragraphs, but the data reveal to what extent they are responsible for bringing down the quality of milk. In this connexion the influence of tropical conditions of temperature, humidity and dust in providing greater scope for contamination and in accelerating bacterial growth in milk should be kept in view. Accordingly, there is considerable fluctuation in the extent of

bacterial contamination in milk from place to place and from season to season, which makes the problem of sanitary control highly complicated.

The predominant types of microflora found in raw milk supplies drawn from different sources have been reported to be coliform bacteria, micrococci, lactic streptococci, spore-forming aerobes and corynebacteria, the majority of them being utensil contaminants. Although the coliform bacteria were initially present in smaller numbers than other species, their rate of growth and activity in milk was much greater, particularly during the summer. The high incidence of thermophilic organisms in milk supplies has already been mentioned.

The results of another investigation, aimed at finding possible ways of improving the quality of milk produced in an organized farm during the summer (mean atmospheric temperatures varying from 35° to 45°C) by adopting a special programme of clean milk production are presented in Table 2. Various sanitary precautions in the production and handling of

TABLE 2  
EFFECT OF SPECIAL "CLEAN MILK PRODUCTION" PROGRAMME  
ON THE HYGIENIC QUALITY OF FARM MILK (AVERAGE OF 15 TRIALS)

Source of milk sample	Age from time of production (hours)	Standard plate count (per ml)	Coliform count (per ml)	Methylene blue reduction test (hours-mins.)
<b>Before introduction of sanitation programme</b>				
Milking pail	0	7 650	0	5-00
Herd sample	1-2	71 000	3 200	4-10
Dairy bulk	2-3	3 200 000	11 200	2-45
<b>After introduction of sanitation programme</b>				
Milking pail	0	1 580	0	9-00
Herd sample	1-2	3 600	30	6-50
Dairy bulk	2-3	9 700	120	6-15

milk were introduced, but the most important innovation was that of efficient cleansing of utensils by rinsing with chlorine solution just before use. It may be seen that as a result of adopting the "clean milk production" programme it was possible to improve the quality of dairy bulk milk to a very high level (standard plate counts of less than 10 000 per ml). Similar studies carried out to improve the quality of milk produced in village centres affiliated to a co-operative milk union have given very encouraging results. From this it may be inferred that once the production and distribution of milk in India are established on an organized basis, the problems of milk hygiene could be solved successfully. However, in view of the rigorous tropical conditions prevailing in India it is all the more necessary to impose the highest standards of cleanliness and hygiene in the production and handling of market milk.

### **Milk-borne Diseases**

Considering the highly insanitary conditions of production and the numerous sources of infection to which milk is exposed during its handling, the type of milk sold in the market or delivered to the consumers in India may be expected to be a potential vehicle for communicating various diseases to man. Since milk is generally boiled before consumption the danger of infection by pathogens is greatly minimized. This aspect has not received much attention in India and even though there are quite a number of outbreaks of diseases such as diphtheria, dysentery and typhoid fever, the possibility of incriminating milk as the source of infection has not generally been considered. Similarly, the transmission of diseases such as tuberculosis, brucellosis and septic sore throat from infected animals through milk has also been given little serious attention. Since in many instances such infected animals live in close proximity to human beings, the risk of direct infection is always present. In recent years considerable attention has been given to the possible role of heat-stable toxins, produced by certain species of bacteria growing in milk, particularly in causing gastro-enteritis and other intestinal disorders in children. This is a problem of considerable significance to India in view of the high bacterial content of raw milk supplies and the incidence and growth of various types of organism in milk before it reaches the consumer.

In this connexion another point that deserves special attention, particularly in the light of the developments now taking place in India towards the introduction of pasteurizing units in many of the urban areas, is that very strict vigilance and effective public health control must be maintained on the process of pasteurization if large-scale transmission of diseases through milk is to be avoided. In the absence of such controls it is quite possible that milk may not receive adequate heat treatment, and bottled milk labelled "pasteurized milk" may be consumed without boiling by the consumers. It is therefore the special responsibility of the organizations undertaking such large-scale processing of milk to ensure that any bottled milk labelled "pasteurized milk" satisfies rigid public health standards.

### **Milk Legislation and Public Health Supervision**

The multiplicity of persons and agencies involved in the production, collection and supply of milk, and the small quantities of milk handled in each case, make it very difficult to exercise any effective public health control over the market milk industry or to improve the hygienic standards of the milk trade. This factor, combined with the sense of security created by the universal habit of boiling milk as a guarantee against any risk of infection from pathogens, has probably kept the sanitary aspects of the milk industry in the background.

At present the control measures in practice are directed mainly towards the prevention of adulteration of market milk. Municipal acts in different states and in the major corporations of Bombay, Calcutta and Madras include certain model rules and by-laws relating to the construction and maintenance of cattle-sheds and milk-shops, and the cleanliness of milk stores, milk utensils, etc. Most of these regulations are, however, based on laws laid down in other countries and are not related to local needs and conditions. In any case, they are seldom enforced in actual practice, owing to the absence of effective machinery for the purpose, and other difficulties.

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