BACTERIOLOGICAL QUALITY OF GOAT MILK

By

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "BACTERIOLOGICAL QUALITY OF GOAT MILK" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship, or other similar title, of any other University or Society.

Mannuthy,
30-12-1985

KEVESIDI CHAKRESANG

CERTIFICATE

Certified that this thesis, entitled "BACTERIOLOGICAL QUALITY OF GOAT MILK" is a record of research work done independently by Sri. Kevesiei Chakhesang under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship, or associateship to him.

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To

My loving parents

CONTENTS

Introduction

1. INTRODUCTION

The domestic goats belonging to the species, Capra hircus, commonly known as poorman's cow, are believed to have descended from a species of wild goats. They were probably the first animals to be domesticated after dog, and were brought into a symbiotic relationship with man. The milk-producing ability of goats in addition to meat, might have been an important reason for its domestication. The total goat population in the world is reported to be 467,135,000 (FAO, 1983) and that of India 78 million.

In recent years goat population in India is increasing at a faster rate in comparison to that of sheep and cows, which indicates its wide adaptability to the climatic conditions of the country. Keeping in view of the contributions and importance of goats, in rural economy, several research and developmental programmes have been taken up by the Indian Council of Agricultural Research, Agricultural Universities, State and Central Governments. All the research programmes pertaining to goats pave way for better prospects for the future of goat production.

Milk is vulnerable to microbial contamination and extremely perishable since it provides an ideal medium for the profuse growth and multiplication of microbes. The possibility of pathogenic and toxin producing organisms

gaining access into milk from infected animals and persons coming in contact with milk or indirectly through contaminated equipments and various other sources may seriously affect its safety for human consumption. Though milk is an ideal and perfect food, it can lose its intrinsic value by the activities of micro-organisms and can cause health hazards if proper precautions are not taken during its production and handling.

Assessment of the microbial flora in milk provides a means to detect (a) the sanitary conditions under which milk is produced or processed, (b) extend of keeping quality and (c) the presence or absence of pathogenic or other types of organisms.

In general, the bacteriological quality of raw milk produced in our country is poor. During the last few decades, several studies have been carried out in different parts of the country to examine the bacteriological quality of raw milk samples collected from organised farms, city market and several collection centres and the results have been quite alarming.

Studies on the bacteriological quality of goat milk has received limited attention. In fact, the quality of goat milk from the bacteriological point of view is virtually unexplored in the country. Therefore an extensive

bacteriological investigation of goat milk is considered to be quite essential.

So far, no study has been carried out to find out the bacteriological quality of goat milk in Kerala. A detailed study in this direction will give an indication of various types of organisms like coliforms, thermophilic bacteria, psychrotrophs etc. that may be present in the milk and their influence on the keeping quality.

The present investigation was undertaken at the All India Co-ordinated Research Project on Goats for Milk, Mannuthy, with a view to evaluate the bacteriological quality of aseptically collected fresh goat milk samples and farm pooled raw goat milk samples. An attempt is made to find out the various bacterial counts such as the standard plate count, thermophilic count, psychrophilic count and coliform count of the milk samples collected. Methylene blue reduction test and clot-on-boiling test were also carried out to find out the keeping quality of the milk. All the tests were carried out as soon as the samples were collected. The result of this study would be of much use in identifying the sources of bacterial contamination of milk which may provide a guideline for the production of goat milk under sanitary conditions.

Review of Literature

2. REVIEW OF LITERATURE

Published reports on the bacteriological quality of goat milk are scanty. Information regarding this aspect is apparently absent in India. The available reports on bacteriological quality of milk are reviewed hereunder.

2.1. Udder preparation

Pre-milking udder preparations have been reported to affect milk quality as measured by bacterial count (Galton et al., 1982). They observed that milking without preparation of udder and teats had a higher standard plate count due to soiled teats and machine attachment. Galton et al. (1984) found that the methods of milking resulting in lower bacterial counts in milk were the use of water hose, wet towel, or pre-milking disinfectant teat dip followed by drying with paper towels. The counts of coliform and Staphylococcus sp. were found to show similar trends.

In an experiment, Galton (1984) tried the effects of an udder wash sanitizer iodophor (25 ppm) followed by drying with paper towels. He found that forestripping alone, or wetting the udder and teats without manual drying, did not sufficiently remove bacteria or water containing bacteria. He concluded that the use of a sanitizer gave no benefit when used with a wet towel. Thorough manual

drying of teats was found essential in reducing the bacterial count, sediment and chemical residue in milk.

American Public Health Association (1953) prescribed thorough washing of the udder and teats of each animal, and drying with clean towel and removal of excess moisture promptly before obtaining samples.

Mckinnon et al. (1983) conducted trials with ten cows to find out the bacteriological quality of milk. The cows were kept on dirty sawdust, clean straw or dirty straw bedding. Before milking the teats were either unwashed or washed with cold water or sodium hypochlorite solution (available chlorine 600 mg/litre) and dried with a paper towel or left wet. They found that even under the same bedding and teat washing conditions, there were considerable variations in bacterial counts and sediment in milk. Overall washing with sodium hypochlorite and drying, reduced the total bacterial and coliform counts, compared to other treatments.

In a survey carried out by Chamings (1984) to find out the somatic cell and total bacterial counts of herd bulk milk, in relation to the methods of udder preparation before milking, it was noticed that the milk sample obtained after washing of the udder with a disinfectant solution had similar somatic cell count and total bacterial count as

the sample obtained without using the disinfectant solution for washing the udder.

Dharam and Lavania (1973) showed that the samples of milk collected with washed hands, from washed and dry udder and excluding foremilk, gave the minimal bacterial count.

It was reported by Muller (1955) that iodine detergent sanitizer, at a concentration of 25 ppm of available iodine, gave about the same bacterial destruction as 100 ppm of available chlorine, in the form of calcium hypochlorite, when four nonspore-forming organisms were used as test cultures and comparisons were made in the presence of hard water, milk, or dishwash soil.

Sakya and Srivastava (1982) studied six hygienic practices in milking, either singly or in combination. They showed that the practice of washing and disinfection of milkers' hands with disinfectant solution (200 ppm of available chlorine) reduced the bacterial count by 79.7%, washing the udder caused a reduction of 83.6%, washing of milking pails with 50 ppm iodophor caused reduction by 63.3% and a combination of all the six practices resulted in a reduction of 80.44%. Bacterial swab showed that udder, milking pail, milk can and milkers' hands were all potential sources of contamination. They concluded that extra cost involved in following the hygienic measures appeared

to be negligible compared with the gains obtained through improved milk quality.

2.2. Water for phosphate buffered dilution blank

The different sources of potassium dihydrogen phosphate used for preparing phosphate buffered dilution water have various effects on the ability of the dilution water to maintain a stable bacterial population. Jensen and Hausler (1976) in an investigation showed that when the water used for preparing the dilution blanks was of either very good or very poor quality, the potassium dihydrogen phosphate source was of no consequence. But, when the water was of an intermediate quality the source of potassium dihydrogen phosphate became important in the overall quality of the system. They concluded that distilled water of very good and consistent quality may have to be made available so as to eliminate the toxic factors in the potassium dihydrogen phosphate.

Geldreich and Clark (1965) recommended that the distilled water for microbiological use should be free of inorganic and organic substances, either toxic or nutritive, that could influence survival or growth of bacteria and viruses. Theoretically distilled water should only contain H_2O.

There was no significant difference between diluents (phosphate buffer, quarter strength Ringers solution,

distilled water or 0.1% peptone in distilled water) in mean log cell count or in the survival of bacteria as per analysis made by Schoebitz and Gesche (1979 and 1980). Further, there were no significant differences in all counts due to incubation time, although the highest mean count was obtained after 48 hours.

2.3. Total bacterial count

In an investigation, Berry et al. (1969) found that a delay in pouring plates after the sample was measured into petri dishes, resulted in a substantial reduction in the plate count. This reduction was due to absorption of cells onto the petri dish surface with the formation of bottom spreaders and not to the lethal effect of the diluent.

Raw milk samples were plated by Kuhtanen et al. (1975) using agar tempered to 45° or 50° ± 1°C. The standard plate count was significantly lower with agar at 50°C. There was a significant reduction in raw milk bacterial counts using an agar pouring temperature of 50°C instead of 45°C.

Counts of aerobic mesophilic sporeforming bacteria in buffaloes' raw milk was studied by Shehata et al. (1983). The counts varied from 100 to 81,000/ml, with an average of 9,800/ml. Highest counts were recorded in September and lowest in February. The variation in the counts was greater in summer than in other seasons. The 1,512 aerobic sporeforming bacteria isolated from raw milk consisted mainly of

Bacillus subtilis (42.5%) and B. megaterium (34.8%), followed by B. circulans (4.9%), B. cereus (4.6%), B. pumilus (2.9%), B. badius (1.5%), B. brevis (1.3%), B. pulvifaciens (1.2%), B. coagulans (1.1%),and B. firmus (0.5%).

Rykshina and Smuneva (1982) studied the bacterial contamination of milk on dairy farms with cows (i) tied up on straw bedding with wooden floors and milked in an ADM-8 installation (ii) loose-housed in cubicles (with mucking out by scrapers) and milked in tandem UDT-i parlour, (iii) loose-housed in cubicles (with sherry mucking out) and milked in an UDT-8 herringbone parlour or (iv) loose-housed in groups on periodically changed peat bedding and milked in a rotary M 691-40 parlour. The mean initial count of milk taken aseptically from udder was, 3,000, 8,500, 4,900 and 4,800 organisms/ml during the stall-feeding period, and 13,000, 3,900, 2,000 and 1,700/ml during pasture period respectively. They also studied the effect of using different detergent-sterilizers on the quality of milk and concluded that first quality milk can only be obtained with daily treatment of equipment with detergent-sterilizers and hot water washing directly before each milking.

In a study conducted by Gorinova (1979), the aseptically drawn milk from healthy Russian Black piel cows in their first lactation, had total bacterial counts of 75 ± 17/ml when cows were tied up and housed on wooden floors without

bedding and 135 ± 33/ml when they were loose-housed in slatted floor cubicles. Similar groups of cows in their 3rd-5th lactations had total bacterial counts of 1526 ± 212 and 1269 ± 290/ml respectively. Milk from cows giving a positive result with the Dimastin mastitis test reagent contained higher total bacterial count of 29.078±6,095/ml.

The studies made by Trawinska and Krynska (1982) concluded that the raw milk was heavily contaminated with bacteria, particularly in summer and that the contamination after pasteurization increased progressively with the subsequent processing steps.

Distribution of bacteria in aseptically drawn milk was studied by Bacic et al. (1968) and found that the colony count was highest in foremilk, but the addition of foremilk to the main milk made little difference to the count of the total milk because of the small volume of foremilk. The arithmetic mean of the colony count for four herds comprising of 97 cows was 3,403 bacteria/ml and the colony counts on total milk (foremilk + main milk) from individual cows showed a wide range of distribution; 16% having < 100/ml, 56% < 1000/ml, 97% < 10,000/ml, and only 3% had counts greater than 10,000/ml. A relationship between the colony count of the milk and the age of the cows was noted. The cows in the first or second lactation were showing appreciably lower counts in both

forenilk and total milk than the cows in their third or subsequent lactations.

Francois (1981) reported that at the time of collection of milk from the farm tank (generally 48 hours after the first milking into the tank) Pseudomonas sp. accounted for most or all of the microbial flora of the milk. Thus at the time of testing milk for payment, the psychrocrophic count was not substantially different from the total count at 30°C. It was concluded that replacing total count (3 days at 30°C) with psychrotrophic count (10 days at 7°C) would not be justifiable for payment of milk to the producer.

The median bacterial count was 100/ml in 41% of quarter samples, 10^2-10^3 in 35%, 10^3-10^4 in 23% and $>10^4$/ml in 1% of the aseptically drawn quarter samples from several cows over four months as per study conducted by Vries (1975).

A study was undertaken by Arai (1982) who found that the annual mean bacterial count in raw milk produced in Miyagi prefecture was 2×10^6 to 3×10^5/ml, in between the years 1976 and 1982.

Morse et al. (1968) found that the mean bacterial counts, using samples taken from the Pails after machine-milking with sanitized equipment at the 27 farms ranged from 690 to 15,500 colonies/ml, with a median value of 3,200 in the standard plate count of milk from individual cows. The

bacterial counts had a higher mean and greater variability than what was sometimes assumed. Morse et al. (1968) in another experiment showed that the preliminary incubation generally enhanced both the initial count and counts at all stages of sampling.

No bacterial growth was obtained by Bergmann and Reinhold (1978) from 9.5% of all samples taken from quarters with increased cell count and conductivity, nor from 4.1% of samples from intact quarters. They found that samples from quarters with subclinical mastitis exhibited increases in bacterial count.

In a bacteriological analysis, Lavania (1969) obtained an average of 858700 bacteria/ml in standard plate count and with an average Methylene blue reduction time as 5.32 hours for milk from individual milk produces; 1267500/ml and 3.28 h for milk from milk collection centres; 1406900/ml and 3.41 h for milk from small private dairies; 1733700/ml and 2.18 h for milk from village milk vendors and 1765000/ml and 2.15 h for milk from small-keepers.

According to Dommett et al (1980) the total bacterial counts increased 7% between collection at the farms and subsequent delivery at the factory. Even though the increases were statistically significant, they were found to be within the tolerance allowed for total bacterial counts,

provided the full sanitizing procedure was used once-a-day prior to the first load for the day. No significant effects on the counts could be attributed to the lack of a full treatment between loads. Most counts from farm samples fell within the current Queensland farm milk advisory standard of < 50,000/ml, and the legal standard of < 1,50,000/ml fixed for raw milk.

Akhmedov et al. (1976) in their examination of milk from State farms, got indices which showed low hygienic quality with total bacterial counts ranging from 6,70,000 to 23.6 million/ml and E. coli titres of 1000/ml in 68%, 1,00,000/ml in 15.3% and 10 million/ml in 12.9% of the samples.

In the bacteriological investigation of raw chilled milk Desai et al. (1980) obtained an average standard count of 46 x 10^6/ml. After standardization by mixing with reconstituted skim milk, the standard plate count was reduced to 21 x 10^6/ml, and coliform counts to 45.9 x 10^3/ml, thermoduric counts to 177 x 10^3/ml the thermophilic counts to nil, and the methylene blue reduction time to 32 min. After laboratory and commercial HTST pasteurization the methylene blue reduction time was 8 and 3.75 h, standard plate count 81 x 10^3 and 430 x 10^3/ml, coliform count 2.4 x 10^3 and 43.9 x 10^3/ml and thermoduric count 68 x 10^3 and 95 x 10^3/ml respectively. The samples pasteurized by HTST process

contained thermophilic count of 15 x 10^3/ml. The keeping quality of the laboratory pasteurized samples was better (11.65 h) than commercially pasteurized samples (3.58 h). The standard plate count increased to 99 x 10^4/ml after bottling and cold storage and to 1.3 x 10^6/ml at the time of delivery to the consumer. There were also increases in coliform, thermoduric and thermophilic counts, and the keeping quality of milk reaching the consumer was 4.47 h.

When the samples of milk from milk producer societies were subjected to bacteriological analysis, Desai and Natarajan (1981) found that the methylene blue reduction test time ranged from 15 min to 5 h 30 min, standard plate count from 4 x 10^5 to 1.8 x 10^5/ml, coliform count from 3.1 x 10^4 to 1.1 x 10^6/ml and thermoduric count from 2.2 x 10^4 to 2.4 x 10^6/ml.

Jonson and Hughes (1980) in their bacteriological investigation of raw milk of goats from retail outlets and farms, recorded the standard plate count limit of 10^5/ml exceeding in 33.3% of samples and coliforms count of 10/ml in 49.5%. Both standard plate count and coliform limits were exceeded in 29.9% of samples. Escherichia coli was detected in 60.5% of samples with 11% having >100 E. coli/ml.

On investigation of bacteriological quality of market milk in Udaipur city, the average total and coliform counts

as noted by Vijai and Saraswat (1968) were 1,400,000 and 320/ml for organised dairy farm milk, 3,000,000 and 3,200/ml for city market milk, 6,000,000 and 18,000/ml for rural collection centre milk and 32,000 and 41/ml for the pasteurized milk samples respectively. They classified the Udaipur city raw milk supply into the following four grades:

Superior - Standard plate and coliform counts not exceeding 200,000 and 100/ml.

Satisfactory - Between 200,000-1,000,000 and 101-500/ml.

Acceptable - Between 1-3 million and 501-1000/ml.

Poor - Over 3 million and 1000/ml respectively.

In a bacteriological analysis of raw milk, Jain and Saraswat (1968) found the average standard plate counts, thermoduric counts and psychrophilic counts to be 760,000, 52,000 and 77,000/ml for the organised dairy farm; 8,600,000, 400,000 and 2,900,000/ml for the city market and 11,000,000, 340,000 and 5,000,000/ml for rural milk samples respectively. Samples of milk not exceeding 1,000,000 and thermoduric count not exceeding 50,000/ml were considered to be of satisfactory bacteriological quality.

Rao and Karnane (1978) while grading the quality of milk on the basis of standard plate count found that 65.7% of the chilled milk samples were bad and 34.3% 'very bad' against 50% bad and 50% 'very bad' samples of unchilled milk.

Using MBR test, the minimum and maximum reduction time of chilled milk were 40 min and 150 min respectively. The chilled milk gave a lower coliform count than unchilled milk.

Studying the bacteriological analysis of the milk samples from (i) Dairy Unit, Ranchi Veterinary College, (ii) Local vendors, and (iii) Town pasteurized milk supply units, Yadava et al. (1983) found that the standard plate count/ml of milk to be 10^5 of (i) - (iii) samples respectively, averaged 4.08, 74.20 and 1735.83 during the monsoon season and 0.56, 12.08 and 1881.50 during the winter. Coliform and faecal streptococcal counts showed similar trends. Methylene blue reduction time was highest in (i) followed by (ii) and then (iii) and the differences were significant at $P<0.01$. It was concluded that both bacterial counts and the MBR time were reliable measures of the bacteriological quality of milk.

It was found by Dwivedi (1976) that the standard plate count of market milk in Rewa city was 3.89 million/ml while the MBR time averaged 1½ hour. There were samples of milk which gave as high as 27 million bacteria/ml with less than 35 min Methylene blue reduction time.

Singh et al. (1974) conducted bacteriological analysis of milk in Kanpur city. The average standard plate count of

aseptically drawn milk, production-end milk and supply-end milk were found to be 2,825; 315,600 and 1,061,600/ml respectively. There was more than hundred-fold increase in bacterial number from aseptically-drawn milk to the production-end milk and production-end to supply-end milk was about three-fold. No coliform was found in aseptically-drawn milk. The average coliform counts in production-end and supply-end milk was 1310 and 5600/ml respectively. Based on the clot-on-boiling test the average keeping quality was found to be 44 h, 13.5 h and 10.5 h for aseptically drawn milk, production-end milk and supply-end milk respectively.

Microbial population of grade A raw milk samples from individual producers and bulk tank trucks (commingled) were studied by Randolph et al. (1973). The standard plate count ranged from 800-630,000 with a mean of 70,000, psychrotrophic bacterial count 5-430,000 with a mean of 25,000 and coliform count 5-49,000 with a mean of 1200/ml for the samples from individual producers. The commingled samples from bulk tank trucks had standard plate count ranging from 2,000-940,000 with a mean of 100,000, psychrotrophic bacteria count from 20-760,000 with a mean of 34,000 and coliform count 5-10,000 with a mean of 830/ml.

It was reported by Reinbold (1971) that the bacteriological analysis of raw milk and processed dairy products was

not adequate for public health and quality control purposes. Bacteriological test results were not highly correlated with farm productions. Routine bacterial quality control tests were not adequate for recovery of micro-organisms injured during processing.

Hunter (1984) in his bacteriological analysis of goat milk, found less than 100 bacteria/ml of milk in 80% of samples from uninfected udders. About 80% of infected samples had bacterial counts in excess of 1000/ml but only 3.6% of uninfected samples had counts in this range. No coliform organisms were detected except in one sample from a goat having clinical mastitis.

Abo-Elnaga and Abd-Elmoteleb (1968) in their bacteriological analysis of market milk supplies found that the heat treated milk had more bacteria and coliform number frequently in summer and autumn than in winter. In summer 85.6% of the raw milk samples contained from 10^5 to 10^9 bacteria/ml and 64.7% contained from 10^4 to 10^6 coliform bacteria/ml. In autumn 77.4% of the raw milk samples contained from 10^6 to 10^8 bacteria/ml and 56.2% of the samples had 10^4 to 10^6 coliforms/ml. In winter the count fell in the range of 10^4 to 10^7/ml. The number of coliform was markedly low, sometimes reaching 10^4 to 10^5/ml.

The milk from grade-A farms was subjected to bacteriological tests including the standard plate, total, coliform,

psychrophilic, thermoduric, and enterococcus count, resazurin reduction time and leucocytes count to determine the correlation between these tests and farm production conditions; and according to Hartley et al. (1968) the psychrophilic count (at 7° ± 1°C for 10 d) was the only bacterial test that showed significant correlation with the farm score. However, the psychrophilic bacterial count was relatively expensive and time consuming.

A study was undertaken by Reddy et al. (1984) under field conditions at Milk Product Factory, Andhra Pradesh Dairy Development Corporation (Pvt.) Limited, Vijayawada to assess the bacteriological quality of milk and it was found that the coliform counts ranged from 4,280 to 132,000/ml with an average of 2,866/ml and the standard plate count ranged from 0.77 to 29.40 million/ml of raw milk.

Gajdusek (1933) made a study of microbiological quality of raw milk for one year in 14 dairy factories and found that the mean total bacterial count over the period was 3,37,000/ml; mean psychrotrophic bacterial count 64,900/ml; and mean coliform count over the whole year was 7,320/ml.

2.4. Psychrophilic bacterial count

The dairy industry considers psycnrophils as those organisms that grow in milk or its products at refrigeration temperatures at such a rate as to cause objectionable changes

before consumption. In general, these organisms are of soil and water origin (Overcast, 1968).

Bacterial counts were determined by Ohlrich and McKellar (1983) on raw and pasteurized milk after incubation at 7°C for 10 days and at 18°C for 45 h and close correlations were obtained between the numbers of micro-organisms after 18°C/45 h and 7°C/10-day incubations in raw ($r = 0.866$) and pasteurized ($r = 0.936$) milk samples.

The bacterial analysis of bulk-cooled milk incubated at 32°C for 48 h, 20°C for 48 h, 20°C for 72 h, 5°C for seven days, and 5°C for ten days were studied by Atherton (1953). He found that there was no advantage in incubating plates at 5°C for ten, rather than seven days or at 20°C for three, rather than two, days.

The milk samples from Iowa Dairies on analysis by Orange and Nelson (1961) found that the standard plate count of 37.7% of the samples exceeded 1,000,000/ml as compared to 26.5% at this level for the psychrophilic plate count. The plates for the psychrophilic count were incubated at 5°C for seven days.

Various investigators have found that the psychrophilic count in raw milk, with plates incubated at 7°C for ten days, often greatly exceeded the standard plate count (Johns, 1971).

No psychrophilic organisms were recovered from one ml

portions of freshly pasteurized samples by Watrous et al (1971). However, after ten days storage at 7.2°C, 10.4% of the samples showed viable psychrophilic organisms.

The count of psychrophilic bacteria in milk samples from farm tanks was determined by Lund and Sogaard (1980) using incubation periods of (i) 17°C for 17 h + 7°C for 3 days, (ii) 21°C for 25 h or (iii) 7°C for 10 days (standard method) and the statistical analysis of results suggested that (ii) could not be recommended, whereas results of (i) were similar to the standard method.

A bacteriological study of liquid milk processing at a Danish Dairy, at all stages from primary production to the sell-by date, was conducted and the analysis of raw milk by Lund and Sogaard (1981) revealed that certain farms had high psychrotrophic counts both in summer and winter. Geometric means of psychrotrophic counts for all farms were much higher in summer than in winter (2100-4700 vs 630-650/ml) but total bacterial counts determined at 30°C were approximately the same in both the seasons. Growth of psychrotrophs in the final pasteurized milk (held for 6 days at 5°C in unopened cartons) did not appear to be directly related to psychrotrophic counts before pasteurization.

In another study, Lund and Sogaard (1982) found the geometric mean of total bacterial count/ml increased from

1,760 to 3,270 in whole 600 to 770 in skim, 1,280 to 2,380 in low fat and 250 to 1,280 in Jersey milk. By plating in plate count agar (17 h at 17°C + 72 h at 7°C) psychrotrophs were not detected in any sample on the day of pasteurization but were detected after 24 h at 17°C.

Psychrotrophic bacterial count obtained after incubation at 21°C for 25 h had good agreement with those obtained by the standard psychrotrophic control (Oliveria and Parmelee, 1976).

Boyd et al. (1954) determined psychrophilic counts using an incubation temperature and time of 4.4°C for 20 days. One difficulty encountered with incubation at 5°C for 7 days was that colonies sometimes were so small that the counting was difficult.

2.5. Thermophilic bacterial count

The grade A raw milk samples from individual producers and bulk tank trucks (commingled) were subjected to microbial counts by Randolph et al. (1973). They obtained the thermophilic count of commingled samples ranging from 5 to 700/ml with a mean of 41/ml. Yeast and mold count ranged from 1 to 900/ml with a mean of 110/ml. According to them occurrence of thermophilic bacteria and yeasts and molds at these relatively low levels appeared to be of little practical significance.

The thermophilic spore count in raw milk from organised dairy farms was found to be 43/ml in a study conducted by Dthiraj et al. (1979).

Desai et al. (1980) in their bacteriological study of raw and laboratory pasteurized milk, could not detect any thermophilic bacteria but the milk subjected to MTST gave 15×10^3 thermophilic bacteria/ml.

2.6. Coliform count

When boiled Violet Red Bile agar was used, an incubation period of 48 h was required for water, frozen vegetable, and other materials that contained coliforms which were slow in growth initiation, and an incubation period of at least 24 h was required for dairy products. The pH of prepared Violet Red Bile agar should be 7.2 (Hartman and Hartman, 1976).

In a study undertaken by Matzke and Barbour (1976) it was found that the apex of teats had a large increase in organisms and the coliforms were of gram negative rods. They were faecal or environmental contaminants primarily of Escherichia, Klebsiella and Enterobacter.

Among the coliform organisms isolated from buffalo milk marketed in and around Patna (Kumar et al., 1978) E. coli, Citrobacter freundii and Enterobacter aerogenes represented 12.5, 6.7 and 5.0% respectively.

Luck and Lategen (1983) analysed the samples of raw milk, pasteurized milk and fermented milk for total coliform count by incubation in Violet Red Bile agar for 24 h at 30°C or by a modified method in which a base layer of nutrient agar was overlaid with Violet Red Bile Agar. The modified method gave a 2.7-fold higher count than the Violet Red Bile agar, due to resuscitation of injured coliforms in nutrient agar. For counting faecal coliform in milk, plating in Violet Red Bile agar at 44°C gave a 7-fold higher count than Most probable number method determined in Brilliant Green Bile broth at 44°C for 48 h followed by identification by the modified Dijkman test. It was recommended that the Violet Red Bile plate count at 44°C be used in control laboratories for determining faecal coliforms in milk. If duplicates were made, one could be incubated at 30°C for total coliform count and the other at 44°C for faecal coliform count.

2.7. Methylene Blue Reduction Test

The milk samples from individual cows for methylene blue reduction time were tested by Moorthy and Subramanian (1978) and they reported the average Methylene blue reduction time for Sindhi cows milk as 6.15 h (individual) and 5.96 h (bulk). In cross-bred Jerseys 6.74 h and 6.46 h were obtained for individual and bulk samples respectively.

The number of milk samples in Zimbabwe Rhodesia complying with Methylene blue reduction test of 3 h in summer and 4 h in winter decreased from 87% in 1971-72 to 80% in 1976-77. The number of samples that gave readings of 1 h increased from 1.25% in 1971-72 to 2.48% in 1976-77 (Phillips, 1979).

Krishnappa et al. (1979) in an attempt to develop a simple test for predicting the keeping quality of pasteurized milk, added two nutrients namely yeast extract and beef extract to pasteurized milk and then incubated at 37°C for 1 h to accelerate the Methylene blue reduction time. Methylene blue reduction time for such milk was found to be less than 0-30 min. The keeping quality of the pasteurized milk was carried out to work out the correlation between accelerated reduction Methylene blue reduction time and the keeping quality at ambient temperature and at 30°C. Out of the 90 samples, 51 gave a reduction time less than 0-10 min and keeping quality of 8.00 to 9.00 h at ambient temperature of 26°C, 18 samples gave a reduction time between 0-10 to 0-15 min. and keeping quality of 10.00 to 11.00 h at the ambient temperature. Only 12 samples came under the accelerated reduction time of 0-15 to 0-30 min. for the milk having a keeping quality of 13.00 to 14.00 h. Pasteurized milk samples having a keeping quality of 14.00 to 15.00 h gave an accelerated reduction time of 0-30 min and above and only 9 samples were under this category.

The total bacterial count in milk had a poor correlation with pyruvate (+0.21) but a moderate correlation with Methylene blue reduction time (-0.50). Further Slavchev (1979) concluded that for assessment of bacteriological quality, the Pyruvate test is most accurate for milk cooled at 10°C and the methylene blue reduction test was more suitable for milk cooled at higher temperatures.

The result obtained by Steen (1980) from the study to find the correlation between total bacterial count and methylene blue reduction test was -0.433, -0.461, -0.613 and -0.744 and the correlation between total bacterial count and resaguzin test was +0.323, +0.410, +0.574 and +0.607. It was concluded that dye reduction tests did not accurately reflect bacterial counts, especially in milk kept at low temperature.

The correlations between methylene blue reduction time and viable bacterial counts, according to Teixeira et al. (1981) were -0.429, -0.837, -0.762 and -0.295, respectively in milk samples collected from milk producers in Minos Gerais directly after milking during hot, cold and temperate periods in 1973-74 and overnight refrigerated milk.

According to Nader-Filho et al. (1983) the bacterial counts below 5,000,000/ml gave a reduction time of less than 3.5 h for methylene blue. The interference of leucocytes

with methylene blue reduction test did not invalidate the use of the test for routine evaluation of cows milk for human consumption, since variations in its sensitivity, in themselves indicate abnormalities in the milk.

In another study, Nader-Filho et al. (1983) found that the methylene blue reduction time was compatible with the bacterial count measured by the standard place count ($\leq$3.5 h for counts $\geq$ 500,000/ml). All samples of the milk contained less than 100,000 leucocytes per ml.

Reduction times for resazurin and methylene blue in raw milk did not have any correlation with keeping quality of pasteurized milks at 4°, 15°, 22°, 30° or 37°C (Abd-El-hady, 1983).

The data collected on the bacteriological quality of milk in Allahabad and Delhi were subjected to statistical analysis by Marutiram and Singh (1968) and they found the Methylene blue reduction test to be the most reliable test than that of Resazurin test, standard plate count and atmospheric characteristics. Reduction time did not give a precise estimate of keeping quality time particularly in the case of samples taken at production. According to them the keeping quality time did not appear to be affected by the temperature of the milk except in summer to some extent. Humidity appeared to be correlated with the keeping quality in monsoon and summer seasons.

Harmer and Babel (1957) reported that in general, Streptococcus lactis and the coliform bacteria reduced the dye rapidly, whereas certain of the more heat resistant bacteria reduced it slowly. The leucocytes even when present in considerable numbers, only partially, or temporarily, reduced the methylene blue. The slight reduction sometimes noted was nullified by inversion of the tubes which caused the colour to return. The reduction tests do not indicate the actual number of bacteria in milk but give a measure of the extent of bacterial activity which can be used to classify milk as acceptable or non-acceptable. The more rapidly the dye is decolourized, the higher the number of bacteria, however, with various exceptions. Samples having a relatively long reduction time may contain many bacteria of a type that can reduce the dye slowly. With milk having a low plate count originally, Davis and Lines (1939) found no direct relationship between the counts before and after reduction.

Where good sanitary control is maintained and bacterial counts are low, Methylene blue reduction tests have been found to be progressively less applicable (APHA, 1953).

Jackson (1936) reported that milk as it exists in the udder, or milk drawn anaerobically, reduces methylene blue almost instantaneously, whereas the same milk exposed to oxygen usually took >10 h for the reduction to take place.

It was noted by Nilsson (1957) that methylene blue was reduced rapidly in some individual samples of milk. Such samples contained no formaldehyde, the oxygen content was not depleted, and the bacterial count was low. However, reduction of the dye was accompanied by a rapid drop in the oxidation-reduction potential. In samples of aseptically-drawn milk which reacted normally, there was no decrease in potential as long as there was no growth of bacteria. The reducing system in milk was associated with the fat and was destroyed by heating at 85°C for 30 min.

2.8. Clot-on-boiling test

Mukundan et al. (1980) in an investigation, estimated the keeping quality of samples of raw milk stored at a temperature of 29°C by clot-on-boiling test. At this temperature none of the raw milk samples had a keeping quality of 12 hours. The samples collected from the individual households had the highest keeping quality and the samples from University Livestock Farm were better than those from Co-operative Milk Supply Union, Trichur.

In spite of the high bacterial counts, Desai and Natarajan (1980) found that the clot-on-boiling test was negative for all samples collected from chilling centres to the processing dairy indicating that the microbial population was mainly composed of micrococci and sporeformers which would have an

adverse effect on organoleptic and keeping qualities of pasteurized milk.

The maximum keeping quality at 22°C for pasteurized milk of cows observed by Sinha and Singh (1968) was 49 h and the minimum 25 h with an average of 35.76 h. Also in pasteurized milk of buffaloes, similar variations were observed but the average keeping quality was much less being 28.36 h. The storage of milk for 5 h at cold storage did not result in any significant reduction in the keeping quality time. However, after distribution, the keeping quality of cow and buffalo milk were 21.12 and 15.24 h respectively. The average acidity (as per cent lactic acid) of buffalo milk when clot-on-boiling test was shown positive was low, the value being 0.21% as compared to 0.25% for that of cow milk, although the average initial acidity of both these milks was 0.16%.

Materials and Methods

3. MATERIALS AND METHODS

3.1. Experimental animals

For the investigation of bacteriological quality of goat milk, 14 healthy goats without any udder infection were selected at random from the All India Co-ordinated Research Project on Goats for Milk, Mannuthy. The details of the selected goats are presented in Table 1.

3.2. Preparation of udder

The udder and teats were cleaned with the sanitizer, iodophor solution (25 ppm) followed by drying with a clean dry towel.

3.3. Milk samples

After washing and drying the udders and stripping off the foremilk, the points of the teats were swabbed with methylated spirit and approximately 70-80 ml of milk was drawn from each half into separate sterile glass bottles. The milk samples were collected in the morning and evening from the 10th day after kidding and thereafter at an interval of about 15 days till the end of the lactation period.

Commingled farm pooled samples of goat milk were also collected in a sterile bottle from the morning and evening milkings on the same day.

The samples were brought to the laboratory and subjected to different bacteriological tests.

3.4. Water for dilution

Phosphate buffer solution was used for dilution of the samples as per IS:1479, Part III (1962). The stock phosphate buffer solution was prepared by dissolving 34 g of potassium dihydrogen phosphate (KH_2PO_4) in 500 ml distilled water, then adjusted to pH 7.2 with 1N sodium hydroxide solution and made upto one litre with distilled water. For use as water for dilution 1.25 ml of stock phosphate buffer solution was taken and made upto one litre with distilled water.

3.4.1. Preparation of dilution blanks

The dilution bottles were filled with phosphate buffer solution to such an extent that after sterilization in the autoclave at 121°C for 30 minutes, each bottle contained 99 ml.

3.4.2. Selecting dilutions

Selected the dilutions that gave total colonies in between 30 and 300 in the plate. Duplicate plates were prepared at different dilutions.

3.4.3. Identifying plates

Before making dilutions, the plates were arranged in order and identified each one with the sample number and the

dilution to be used therein. Date and plating time for each set of samples were also recorded.

3.4.4. Preparing samples for plating

Immediately before taking the portion of any sample, the contents of each sample were thoroughly mixed as per the procedure given in IS:1479, Part III (1977).

3.4.5. Plating

Plating was done according to the standard procedure prescribed in IS:1479, Part III (1962) using Plate Count Agar and Violet Red Bile Agar in different dilutions of raw farm pooled milk and raw aseptically collected milk. Twelve to fifteen ml of liquefied medium at 42°C to 44°C was poured into each plate containing different dilutions of milk.

For coliform count Violet Red Bile Agar was used and an additional quantity of three to four ml of the medium was distributed over the surface of the solidified medium.

3.4.6. Total bacterial count

The Plate Count Agar having the following composition was used for the total bacterial count.

Plate Count Agar

Tryptone	-	5.0 g
Yeast extract	-	2.5 g
Dextrose	-	1.0 g
Agar	-	15.0 g
Distilled water	-	1000.0 ml
Final pH	-	7.0 ± 0.1

The plates were incubated at 37°C for 48 hours and the colonies were counted in accordance with the procedure laid down in IS:1479, Part III (1962).

3.4.7. Psychrophilic bacterial count

The plate count Agar was used and the plates were incubated at 5°C for seven days as per IS:1479, Part III (1962) and checked whether there was any colony formation.

3.4.8. Thermophilic bacterial count

The plate count Agar was used and the plates were incubated at 55°C for 48 hours and the colonies developed were counted.

3.4.9. Coliform count

The Violet Red Bile Agar of the following composition was used for the coliform count.

Violet Red Bile Agar

Yeast extract	-	3.00 g
Peptone	-	7.00 g
Bile salts	-	1.50 g
Lactose	-	10.00 g
Sodium chloride	-	5.00 g
Agar	-	15.00 g
Distilled water	-	1000.00 ml
Neutral red	-	0.03 g
Crystal violet	-	0.002 g
Final pH	-	7.4 $\pm$ 0.1

Plates were incubated at 37°C for 18-24 hours and the colonies were counted as described in IS:5401 (1969).

3.4.10. Methylene Blue Reduction Test

With sterile pipette, one millilitre of sterile methylene blue thiocyanate solution (0.0075%) was transferred to each sterile tube shortly before placing 10 ml of sample therein as described in Standard methods for examination of dairy products (APHA, 1953). The tests for each sample were conducted at 37°C in water bath. The level of water was maintained at least one inch above the level of the milk in the test tubes. Two control tubes with each batch were put to indicate when decolourisation begin and when it was complete. Inspected the tubes after 30 minutes

followed by inspection at intervals of every one hour till the milk was decolourised. Regarded the milk as decolourised when the whole column of milk is completely decolourised or is completely decolourised upto within 5 mm of the surface and the milk quality was graded according to IS:1479, Part III (1977). This test was carried out to work out the relationship between Methylene blue reduction time and keeping quality.

3.4.11. Clot-on-boiling test

The keeping quality of the goat milk samples of raw pooled farm milk and raw aseptically drawn goat milk was studied at intervals of one hour of storage at room temperature (28°C) upto eight hours and subsequently at intervals of three to six hours till the test showed positive. The keeping quality was assessed by the physical examination and clot on boiling test as per IS:1749, Part I (1960). The samples, which showed clot formation were recorded as positive. The time required for the samples of milk at room temperature to give the clot formation was noted as the keeping quality of the sample.

Results

4. RESULTS

A total of 376 samples of milk aseptically-drawn from 14 goats and 46 samples of farm pooled milk were collected from the All India Co-ordinated Research Project on Goats for Milk for studying the bacteriological quality. The samples were subjected to bacteriological tests such as standard plate count, psychrophilic count, thermophilic count, coliform count and Methylene blue reduction test. The clot-on-boiling test was done for determining the keeping quality of milk samples. The bacteriological quality of the individual goat milk samples is presented in Tables 2 to 15 and that of farm pooled milk samples (at production-end) in Table 17.

4.1. Total bacterial count

The standard plate counts of aseptically-drawn milk collected in the morning and evening from the experimental goats are presented in Tables 2 to 15. The standard plate counts of aseptically-drawn morning milk from five goats (F_2A 209, F_2A 72, 6721, 6773, 6636) and aseptically-drawn evening milk of three goats (F_2A 317, 6721, 6636) were found to be below 100 bacteria/ml throughout their lactation periods. The lowest standard plate count/ml of aseptically-drawn morning milk samples was 17.36 with a range of 0-69 from goat No.6773 and that for evening was 6.43 with a range

of 0-19 bacteria/ml from goat No.6721. The goat No.F_2A 231 was the only one from which the standard plate count/ml was found to be always above 100 bacteria/ml in aseptically-drawn milk samples collected both in the morning and evening throughout the lactation.

The highest standard plate count/ml of aseptically-drawn morning milk sample was 25,350 from goat No.6731 and that of evening was 20,100 bacteria/ml from goat No.AM1 106. The overall mean values of standard plate counts/ml for the morning and evening aseptically-drawn milk were 1956.48 and 744.46 bacteria/ml respectively (Table 16).

The distribution of total bacterial counts of aseptically-drawn milk samples is presented in Table 19. The percentage of samples that gave below 100 bacteria/ml was 61.17 and 64.83 for the morning and evening aseptically-drawn milk samples respectively. In the aseptically drawn milk samples collected in the morning and evening 26.06 and 36.17% respectively were found to fall within the range of 0-10 bacteria/ml. The standard count/ml obtained between 100-1000 and above 1000-30,000 were in 10.11% and 28.72% respectively for morning milk samples and those for evening samples as 18.62% and 17.55%.

The standard plate count of farm pooled milk samples (at production-end) was found to have a range of

21,000-475,000 bacteria/ml with a mean of 116,480/ml in the samples of morning milkings and 14,000-365,000 with a mean of 140,700/ml for evening milkings (Table 17). The distribution of bacterial counts of farm pooled milk samples is presented in Table 20. The percentages of samples that were found to contain within the range of 20,000-100,000 above 100,000-200,000 and above 200,000-500,000 bacteria/ml were 60.87, 26.09 and 13.04 for the morning and 34.78, 47.83 and 17.39 for the evening samples respectively. Thus, 39.13% of the morning milk samples were found to contain above 100,000 bacteria/ml and in the evening milk samples it was 65.22% thereby indicating that the contamination was more in evening milk samples. The data in Table 18 indicate that there was an increase of more than 59 and 188-fold in the bacterial number in the aseptically-drawn milk to the production-end milk for the morning and evening milkings respectively. The correlation coefficient of standard plate count and keeping quality of farm pooled milk samples collected in the morning was -0.46 indicating a significant relationship as against the value +0.24 which was not significant in the samples collected in the evening.

In the grading of the farm pooled milk 87.96% of the morning samples and 82.61% of the evening samples fell within 'very good' grade and 13.04% of morning samples

and 17.39% of evening samples were of 'good' grade as per the standards laid down in ISI the milk produced was of high quality as far as bacterial count was concerned.

4.2. Psychrophilic bacterial count

No psychrophilic bacteria could be detected in any of the sample in aseptically-drawn milk (Table 18) nor in farm pooled milk at production-end (Table 17) throughout the study over 7 months.

4.3. Thermophilic count

The mean thermophilic count/ml of aseptically-drawn morning milk was 0.08 with a range of 0-2 and 0.05 with a range of 0-1 for evening samples while the mean thermophilic count for morning pooled milk was 0.52 with a range of 0-3 and 0.43 with range of 0-2 for evening sample at production-end (Table 18).

4.4. Coliform count

The mean coliform count/ml of all samples of aseptically-drawn morning milk sample was 0.17 with range of 0-4 and 0.11 with range of 0-3 for evening milk samples (Tables 16 and 18). The mean colliform count of farm pooled milk was 3413 with a range of 20-17,200 and 2734 with a range of 60-22,000 for the morning and the evening milk samples, at production-end respectively (Table 17). The

distribution of coliform counts of farm pooled milk is presented in Table 21. The percentage of morning milk samples having counts in the range of 0-10, above 10-100 and above 100 were 39.13, 56.52 and 4.35 and the values were 60.87, 34.78, and 4.35 respectively for the evening milk samples.

4.5. Methylene blue reduction test

The mean Methylene blue reduction time of aseptically-drawn milk samples from the different goats was 14.91 h and 8.93 h for the morning and evening milk samples respectively (Table 16). The results show that there were appreciable variation of Methylene blue reduction time of morning milk with that of evening milk and also from one individual to another.

It was found that 12.23, 31.38, 38.83, 11.70 and 5.35% of the aseptically-drawn morning milk samples and 34.57, 40.96, 17.02, 4.26 and 3.19% of the evening samples gave the reduction time within the range of 0.5-5 h, 6-10 h, 11-20 h, 21-30 h and above 30 h, respectively (Table 22).

The average Methylene blue reduction time of farm pooled milk was 4.57 h with a range of 2.00-6.00 h for the morning milk samples and that of evening milk sample was 3.83 h with range of 2.00-6.00 h (Table 17). The correlation coefficients of Methylene blue reduction time and

keeping quality of morning pooled milk sample were 0.31 and 0.13 for morning and evening milk samples respectively. The values obtained were not found to be significant. The correlation of Methylene blue reduction time with that of standard plate count was found to be -0.21 for the morning and -0.27 for the evening milk samples respectively and they were also not significant.

As per ISI in grading of milk by Methylene blue reduction test 4.35, 39.13 and 56.52% of the samples of morning milkings and 4.35, 73.91 and 21.74% of samples of evening milkings were found to fall within the grades of Fair, Good and Very Good, respectively (Table 23). Based on the Methylene blue reduction test the milk produced in the goat farm was found to be of a high quality.

4.6. Keeping quality

The keeping quality of aseptically-drawn milk samples of individual goat is given in Tables 2 to 15 and the average value of each individual aseptically-drawn milk sample is presented in Table 16.

The overall average mean of keeping quality of aseptically-drawn morning and evening milk samples at room temperature (28°C) were 50.40 h and 44.70 h respectively (Table 16). The keeping quality of aseptically-drawn milk varied greatly (Table 24). It was found that 57.98% of morning and 70.22%

of evening aseptically-drawn milk samples had keeping quality below 50 h while 42.02% of morning and 29.78% of evening milk samples had keeping quality above 50 h. The average keeping quality of farm pooled milk sample was 12.87 h with range of 11-15 h for the morning and 12.04 h with range of 11-15 h for the evening milk samples (Table 17).

Table 1. Particulars of experimental goats

Sl.No.	Animal number	Breed/genetical blood group	Date of birth	Date of kidding	Order of lactation	Duration of lactation (in days)
1	F_2A 266	Alpine x Malabari (2nd generation)	28-8-82	5-3-85	2nd	210
2	F_2A 209	-do-	10-2-82	6-3-85	3rd	209
3	F_2A 231	-do-	1-3-82	9-3-85	1st	202
4	F_2A 72	-do-	2-4-81	17-3-85	4th	198
5	F_2A 331	-do-	8-12-82	20-3-85	1st	201
6	F_2A 317	-do-	23-11-82	31-3-85	2nd	198
7	AAM 106	Alpine-Alpine x Malabari	13-3-82	8-3-85	2nd	207
8	6318	-do-	8-9-78	9-3-85	5th	171
9	6721	-do-	13-1-80	17-3-85	5th	198
10	6773	-do-	27-5-80	18-3-85	3rd	197
11	6279	-do-	5-4-78	18-3-85	5th	197
12	916	-do-	19-9-80	23-3-85	4th	153
13	6636	-do-	12-8-79	1-4-85	4th	201
14	6731	-do-	18-1-80	2-4-85	5th	201

Table 2. Bacteriological quality of aseptically-drawn milk samples from Goat No.F_2A 266

Date of collection	Standard plate count/ml (a)		Coliform count/ml (b)		Thermophilic count/ml(C)		Psychrophilic count/ml (d)		Methylene blue reduction time (in hours)		Keeping quality at room temperature (28°C) in hours	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
17-3-85	2	3	Nil	1	Nil	Nil	Nil	Nil	18	14	80	75
3-4-85	Nil	5	1	Nil	Nil	Nil	Nil	Nil	11	0.5	37	35
18-4-85	18	3	1	Nil	Nil	Nil	Nil	Nil	10	15	72	32
3-5-85	5	20	Nil	3	1	1	Nil	Nil	18	0.5	82	58
14-5-85	5	Nil	Nil	Nil	Nil	Nil	Nil	Nil	22	10	36	32
31-5-85	15	1250	Nil	Nil	Nil	Nil	Nil	Nil	23	19	29	65
17-6-85	13	6	Nil	Nil	Nil	Nil	Nil	Nil	14	17	86	48
3-7-85	18	15	Nil	Nil	Nil	Nil	Nil	Nil	16	10	73	48
16-7-85	248	82	Nil	Nil	Nil	Nil	Nil	Nil	10	6	48	50
5-8-85	16	8	Nil	Nil	Nil	Nil	Nil	Nil	13	8	53	20
19-8-85	1	1	Nil	Nil	Nil	Nil	Nil	Nil	3	2	55	101
4-9-85	16	1	Nil	Nil	Nil	Nil	Nil	Nil	15	24	20	38
17-9-85	1	12	Nil	Nil	Nil	Nil	Nil	Nil	58	25	87	23
1-10-85	3	1	Nil	Nil	Nil	Nil	Nil	Nil	32	12	68	91
Total	361	1407	2	4	1	1	-	-	263	163	826	716
Mean	25.79	100.50	0.14	0.29	0.07	0.07	-	-	18.79	11.64	59.00	51.14
Range	0-248	0-1250	0-1	0-3	0-1	0-1	-	-	3-58	0-5-25	20-87	20-101

(a) = incubated at 37°C for 48 hours (b) = incubated at 37°C for 20-24 hours
(c) = incubated at 55°C for 48 hours (d) = incubated at 5°C for 7 days

Table 3. Bacteriological quality of aseptically-drawn milk samples from Goat No.F_2A 209

Date of collection	Standard plate count/ml (a)		Coliform count/ml (b)		Thermophilic count/ml (c)		Psychrophilic count/ml (d)		Methylene Blue Reduction time (in hours)		Keeping quality at room temperature (28°C) in hours	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
18-3-85	5	25	Nil	Nil	Nil	Nil	Nil	Nil	10	9	27	24
3-4-85	63	43	Nil	Nil	Nil	1	Nil	Nil	9	1	23	27
18-4-85	41	14	Nil	Nil	Nil	Nil	Nil	Nil	9	8	23	40
3-5-85	11	Nil	Nil	Nil	Nil	Nil	Nil	Nil	12	0.5	36	52
14-5-85	3	1	1	Nil	Nil	Nil	Nil	Nil	15	8	52	36
31-5-85	1	1	Nil	Nil	Nil	Nil	Nil	Nil	48	17	72	53
17-6-85	12	2	Nil	Nil	Nil	Nil	Nil	Nil	12	12	72	44
3-7-85	22	8	1	Nil	Nil	Nil	Nil	Nil	44	10	27	18
16-7-85	54	77	Nil	Nil	Nil	Nil	Nil	Nil	11	6	16	16
5-8-85	47	110	Nil	Nil	Nil	Nil	Nil	Nil	10	8	22	19
19-8-85	4	5	Nil	Nil	Nil	Nil	Nil	Nil	80	7	36	19
4-9-85	1	1	Nil	Nil	Nil	Nil	Nil	Nil	14	24	35	22
17-9-85	2	19	Nil	Nil	Nil	Nil	Nil	Nil	17	15	18	23
1-10-85	2	3	Nil	Nil	Nil	Nil	Nil	Nil	130	33	36	20
Total	268	310	2	-	-	1	-	-	421	158.5	495	413
Mean	19.14	22.14	0.14	-	-	0.07	-	-	30.07	11.32	35.36	29.50
Range	1-63	1-110	0-1	-	-	0-1	-	-	9-130	0.5-33	16-72	16-52

(a) = incubated at 37°C for 48 hours
(b) = incubated at 37°C for 20-24 hours
(c) = incubated at 55°C for 48 hours
(d) = incubated at 5°C for 7 days

Table 4. Bacteriological quality of aseptically-drawn milk samples from Goat No. F_2A 231

Date of collection	Standard plate count/ml (a)		Coliform count/ml (b)		Thermophilic count/ml (c)		Psychrophilic count/ml (d)		Methylene Blue reduction time (in hours)		Keeping quality at room temperature (28°C) in hours	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
18-3-85	425	410	Nil	Nil	Nil	Nil	Nil	Nil	9	7	48	96
3-4-85	1570	1500	Nil	Nil	1	Nil	nil	Nil	9	5	50	41
18-4-85	1360	420	Nil	Nil	Nil	Nil	Nil	Nil	10	8	78	50
3-5-85	2320	690	1	3	1	Nil	Nil	Nil	11	0.5	72	50
14-5-85	23875	3350	Nil	Nil	1	Nil	Nil	Nil	8	8	96	72
31-5-85	1170	4070	Nil	Nil	Nil	Nil	Nil	Nil	6	3	9	3
17-6-85	1300	550	Nil	Nil	Nil	Nil	Nil	Nil	10	6	10	19
3-7-85	196	315	Nil	Nil	Nil	Nil	Nil	Nil	1	2	67	48
16-7-85	7850	3400	Nil	Nil	Nil	Nil	Nil	Nil	2	2	36	40
5-8-85	8750	3750	Nil	Nil	Nil	Nil	Nil	Nil	7	3	72	48
19-8-85	1600	690	Nil	Nil	Nil	Nil	Nil	Nil	3	4	58	36
4-9-85	2100	850	Nil	Nil	Nil	Nil	Nil	Nil	2	1	39	70
17-9-85	8450	3250	Nil	Nil	Nil	Nil	Nil	Nil	6	4	29	56
Total	60966	23245	1	3	3	-	-	-	84	53.5	664	629
Mean	4689.69	1788.08	0.08	0.23	0.23	-	-	-	6.46	4.12	51.08	48.38
Range	196-23875	315-4070	0-1	0-3	0-1	-	-	-	1-11	0.5-8	9-96	3-96

(a) = incubated at 37°C for 48 hours
(b) = incubated at 37°C for 20-21 hours
(c) = incubated at 55°C for 48 hours
(d) = incubated at 5°C for 7 days

Table 5. Bacteriological quality of aseptically-drawn milk samples from Coat No. F_2A 72

Date of collection	Standard plate count/ml (a)		Coliform count/ml (b)		Thermophilic count/ml (c)		Psychrophilic count/ml (d)		Methylene Blue reduction time (in hours)		Keeping quality at room temperature (28°C) in hours	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
27-3-85	13	42	Nil	Nil	Nil	Nil	Nil	Nil	9	7	96	72
12-4-85	5	12	Nil	Nil	Nil	Nil	Nil	Nil	9	25	98	80
24-4-85	4	5	4	Nil	Nil	Nil	Nil	Nil	18	15	88	80
9-5-85	16	5	1	1	Nil	Nil	Nil	Nil	20	10	72	96
23-5-85	11	1	Nil	Nil	Nil	Nil	Nil	Nil	20	19	30	18
6-6-85	27	11	Nil	Nil	Nil	Nil	Nil	Nil	15	4	9	8
17-6-85	30	17	Nil	Nil	Nil	Nil	Nil	Nil	17	12	19	18
3-7-85	57	17	Nil	Nil	Nil	Nil	Nil	Nil	12	17	20	18
16-7-85	69	320	Nil	Nil	Nil	Nil	Nil	Nil	12	6	18	20
5-8-85	9	29	Nil	Nil	Nil	Nil	Nil	Nil	23	6	20	19
19-8-85	36	Nil	Nil	Nil	Nil	Nil	Nil	Nil	29	22	29	96
4-9-85	31	2	Nil	Nil	Nil	Nil	Nil	Nil	25	16	56	22
19-9-85	2	3	Nil	Nil	Nil	Nil	Nil	Nil	26	10	28	23
1-10-85	2	1	Nil	Nil	Nil	Nil	Nil	Nil	15	12	30	124
Total	312	465	5	1	-	-	-	-	250	211	622	694
Mean	22.29	33.21	0.36	0.07	-	-	-	-	17.86	15.07	44.43	49.57
Range	2-69	0-320	0-4	0-1	-	-	-	-	12-29	4-42	9-98	8-124

(a) = incubated at 37°C for 48 hours
(b) = incubated at 37°C for 20-24 hours
(c) = incubated at 55°C for 48 hours
(d) = incubated at 5°C for 7 days

Table 6. Bacteriological quality of aseptically-drawn milk samples from Goat No.F_2A 331.

Date of collection	Standard plate count/ml (a)		Coliform count/ml (b)		Thermophilic count/ml (c)		Psychrophilic count/ml (d)		Methylene blue reduction time (in hours)		Keeping quality at room temperature (28°C) in hours	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
9-4-85	8	595	Nil	Nil	Nil	Nil	Nil	Nil	0.5	1	58	72
24-4-85	53	82	Nil	Nil	Nil	Nil	Nil	Nil	3	2	78	98
9-5-85	205	4	Nil	Nil	Nil	Nil	Nil	Nil	8	10	96	120
23-5-85	9	7	Nil	Nil	2	1	Nil	Nil	22	15	22	15
6-6-85	23	16	Nil	1	Nil	Nil	Nil	Nil	18	9	20	20
17-6-85	165	67	Nil	Nil	Nil	Nil	Nil	Nil	12	10	16	12
3-7-85	20800	375	1	Nil	Nil	Nil	Nil	Nil	16	10	36	62
16-7-85	285	139	1	Nil	Nil	Nil	Nil	Nil	10	6	16	22
5-8-85	70	48	Nil	Nil	Nil	Nil	Nil	Nil	9	6	22	39
19-8-85	1190	540	Nil	Nil	Nil	Nil	Nil	Nil	6	4	29	24
4-9-85	4900	1655	Nil	Nil	Nil	Nil	Nil	Nil	5	2	20	38
17-9-85	48	17	Nil	Nil	Nil	Nil	Nil	Nil	5	2	21	45
1-10-85	570	320	Nil	Nil	Nil	Nil	Nil	Nil	1	1	53	47
15-10-85	310	13	Nil	Nil	Nil	Nil	Nil	Nil	4	2	59	26
Total	28636	3878	2	1	2	1	-	-	119.5	80	546	640
Mean	2045.43	277.00	0.14	0.07	0.14	0.07	-	-	8.54	5.71	39.00	45.71
Range	8-20800	4-1655	0-1	0-1	0-2	0-1	-	-	0.5-22	1-15	16-96	15-98

(a) = incubated at 37°C for 48 hours
(b) = incubated at 37°C for 20-24 hours
(c) = incubated at 55°C for 48 hours
(d) = incubated at 5°C for 7 days

Table 7. Bacteriological quality of aseptically-drawn milk samples from Goat No. F_2A 317

Date of collection	Standard plate count/ml (a)		Coliform count/ml (b)		Thermophilic count/ml (c)		Psychrophilic count/ml (d)		Methylene Blue reduction time (in hours)		Keeping quality at room temperature (28°C) in hours	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
9-4-85	13	8	Nil	Nil	Nil	Nil	Nil	Nil	12	8	96	78
24-4-85	10	15	Nil	Nil	Nil	Nil	Nil	Nil	22	2	56	48
9-5-85	16	Nil	Nil	Nil	Nil	Nil	Nil	Nil	18	13	150	120
23-5-85	1	1	Nil	Nil	Nil	Nil	Nil	Nil	22	30	25	22
6-6-85	5	4	Nil	Nil	Nil	Nil	Nil	Nil	28	18	45	17
17-6-85	55	32	Nil	Nil	Nil	Nil	Nil	Nil	18	12	18	24
3-7-85	158	61	1	Nil	Nil	Nil	Nil	Nil	16	10	20	15
16-7-85	242	47	Nil	1	Nil	Nil	Nil	Nil	10	6	18	22
5-8-85	18	5	Nil	Nil	Nil	Nil	Nil	Nil	9	68	22	29
19-8-85	2	1	Nil	Nil	Nil	Nil	Nil	Nil	26	35	90	55
4-9-85	29	1	Nil	Nil	Nil	Nil	Nil	Nil	20	38	56	38
17-9-85	2	47	Nil	Nil	Nil	Nil	Nil	Nil	24	10	50	15
1-10-85	28	7	Nil	Nil	Nil	Nil	Nil	Nil	16	9	68	30
15-10-85	15	2	Nil	Nil	Nil	Nil	Nil	Nil	120	24	150	41
Total	594	231	1	1	-	-	-	-	361	283	864	554
Mean	42.43	16.50	0.07	0.07	-	-	-	-	25.79	20.21	61.71	39.57
Range	1-242	0-47	0-1	0-1	-	-	-	-	0-120	2-68	18-150	15-120

(a) = incubated at 37°C for 48 hours (b) = incubated at 37°C for 20-24 hours
(c) = incubated at 55°C for 48 hours (d) = incubated at 5°C for 7 days

Table 8. Bacteriological quality of aseptically-drawn milk samples from Cow No.AAM 106

Date of collection	Standard plate count/ml (a)		Coliform count/ml (b)		Thermophilic count/ml (c)		Psychrophilic count/ml (d)		Methylene Blue Reduction time (in hours)		Keeping quality at room temperature (28°C) in hours	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
18-3-85	9900	20100	Nil	Nil	Nil	Nil	Nil	Nil	5	1	19	16
3-4-85	1985	840	Nil	1	Nil	Nil	Nil	Nil	11	0.5	30	25
18-4-85	1570	1270	Nil	Nil	Nil	Nil	Nil	Nil	10	8	36	21
3-5-85	2375	550	Nil	Nil	Nil	Nil	Nil	Nil	12	0.5	18	38
14-5-85	2310	1690	Nil	Nil	Nil	Nil	Nil	Nil	9	7	27	21
31-5-85	2725	24	Nil	Nil	Nil	Nil	Nil	Nil	10	10	29	19
17-6-85	27	15	Nil	Nil	Nil	Nil	Nil	Nil	18	12	33	29
3-7-85	5850	1405	Nil	Nil	Nil	Nil	Nil	Nil	13	7	45	38
16-7-85	8750	2135	Nil	Nil	Nil	Nil	Nil	Nil	10	10	18	28
5-8-85	1955	755	Nil	Nil	Nil	Nil	Nil	Nil	13	3	108	19
19-8-85	8750	3300	Nil	Nil	Nil	Nil	Nil	Nil	13	5	55	30
4-9-85	5600	1550	Nil	Nil	Nil	Nil	Nil	Nil	13	7	70	64
17-9-85	1930	1540	Nil	Nil	Nil	Nil	Nil	Nil	13	15	84	96
1-10-85	2795	2325	Nil	Nil	Nil	Nil	Nil	Nil	11	9	68	96
Total	56522	37499	Nil	1	-	-	-	-	161	95	640	540
Mean	4037.29	2678.50	-	0.07	-	-	-	-	11.50	6.79	45.71	38.57
Range	27-9900	15-20100	-	0-1	-	-	-	-	5-18	0.5-15	18-108	21-96

(a) = incubated at 37°C for 48 hours (b) = incubated at 37°C for 20-24 hours
(c) = incubated at 55°C for 48 hours (d) = incubated at 5°C for 7 days

Table 9. Bacteriological quality of aseptically-drawn milk samples from Goat No.6318

Date of collection	Standard plate count/ml (a)		Coliform count/ml (b)		Thermophilic count/ml (c)		Psychrophilic count/ml (d)		Methylene Blue reduction time (in hours)		Keeping quality at room temperature (28°C) in hours	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
18-3-85	10	6	Nil	Nil	Nil	Nil	Nil	Nil	8	9	50	31
3-4-85	18	14	Nil	Nil	Nil	Nil	Nil	Nil	10	8	72	36
18-4-85	655	115	1	1	Nil	Nil	Nil	Nil	8	6	36	30
3-5-85	9200	198	Nil	1	Nil	1	Nil	Nil	2	8	58	36
14-5-85	330	117	Nil	2	Nil	Nil	Nil	Nil	10	7	58	72
31-5-85	10425	2250	Nil	Nil	Nil	Nil	Nil	Nil	10	17	18	53
17-6-85	225	115	1	Nil	Nil	Nil	Nil	Nil	14	12	74	20
3-7-85	3100	1060	Nil	Nil	Nil	Nil	Nil	Nil	12	1	23	67
16-7-85	2750	595	Nil	Nil	Nil	Nil	Nil	Nil	2	1	26	28
5-8-85	1280	58	Nil	Nil	Nil	Nil	Nil	Nil	3	0.5	96	96
19-8-85	700	250	Nil	Nil	Nil	Nil	Nil	Nil	29	3	29	19
Total	28693	4787	2	4	-	1	-	-	108	72.5	540	488
Mean	2608.45	435.18	0.18	0.36	-	0.09	-	-	9.82	6.59	49.09	49.36
Range	10-10425	6-2250	0-1	0-2	-	0-1	-	-	2-29	0.5-17	18-96	19-96

(a) = incubated at 37°C for 48 hours (b) = incubated at 37°C for 20-24 hours
(c) = incubated at 55°C for 40 hours (d) = incubated at 5°C for 7 days

Table 10. Bacteriological quality of aseptically-drawn milk samples from Goat No.6721

Date of collection	Standard plate count/ml (a)		Coliform count/ml (b)		Thermophilic count/ml (c)		Psychrophilic count/ml (d)		Methylene Blue reduction time (in hours)		Keeping quality at room temperature (28°C) in hours	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
27-3-85	4	14	Nil	Nil	Nil	Nil	Nil	Nil	15	2	48	40
12-4-85	21	4	Nil	Nil	1	1	Nil	Nil	10	4	58	41
24-4-85	9	6	Nil	Nil	1	1	Nil	Nil	8	1	72	56
9-5-85	21	5	Nil	Nil	Nil	Nil	Nil	Nil	11	2	48	56
23-5-85	3	Nil	Nil	Nil	1	Nil	Nil	Nil	15	2	30	22
6-6-85	40	19	Nil	Nil	Nil	Nil	Nil	Nil	13	2	26	45
17-6-85	16	6	Nil	Nil	Nil	Nil	Nil	Nil	17	12	19	18
3-7-85	29	5	Nil	Nil	Nil	Nil	Nil	Nil	16	3	96	67
16-7-85	77	7	Nil	Nil	Nil	Nil	Nil	Nil	17	2	24	20
5-8-85	12	18	Nil	Nil	Nil	Nil	Nil	Nil	2	2	26	39
19-8-85	1	1	Nil	Nil	Nil	Nil	Nil	Nil	8	14	36	40
4-9-85	6	1	1	Nil	Nil	Nil	Nil	Nil	3	2	44	132
17-9-85	3	2	Nil	Nil	Nil	Nil	Nil	Nil	1	1	52	40
1-10-85	19	2	Nil	Nil	Nil	Nil	Nil	Nil	2	2	168	91
Total	261	90	1	-	3	2	-	-	143	51	747	707
Mean	18.64	6.43	0.07	-	0.21	0.14	-	-	10.21	3.64	53.36	50.50
Range	1-77	0-19	0-1	-	0-1	0-1	-	-	1-17	1-12	19-168	18-132

(a) = incubated at 37°C for 48 hours (b) = incubated at 37°C for 20-24 hours
(c) = incubated at 55°C for 48 hours (d) = incubated at 5°C for 7 days

Table 11. Bacteriological quality of aseptically-drawn milk samples from Goat No.6773

Date of collection	Standard plate count/ml (a)		Coliform count/ml (b)		Thermophilic count/ml (c)		Psychrophilic count/ml (d)		Methylene Blue reduction time (in hours)		Keeping quality at room temperature (28°C) in hours	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
27-3-85	7	263	Nil	Nil	Nil	Nil	Nil	Nil	24	6	72	120
12-4-85	15	11	Nil	Nil	Nil	Nil	Nil	Nil	8	6	98	72
24-4-85	25	4	Nil	Nil	Nil	Nil	Nil	Nil	6	10	72	36
9-5-85	5	8	Nil	Nil	Nil	Nil	Nil	Nil	10	8	98	120
23-5-85	27	105	Nil	1	Nil	1	Nil	Nil	31	2	23	15
6-6-85	5	16	Nil	Nil	1	Nil	Nil	Nil	28	9	25	20
17-6-85	5	3	Nil	Nil	Nil	Nil	Nil	Nil	12	10	14	18
3-7-85	44	13	Nil	Nil	Nil	Nil	Nil	Nil	15	4	27	38
16-7-85	69	50	2	Nil	Nil	Nil	Nil	Nil	11	6	30	20
5-8-85	19	28	1	Nil	Nil	Nil	Nil	Nil	12	6	46	19
19-8-85	5	5	Nil	Nil	Nil	Nil	Nil	Nil	52	22	78	30
4-9-85	6	5	Nil	Nil	Nil	Nil	Nil	Nil	22	9	70	17
17-9-85	11	1	Nil	Nil	Nil	Nil	Nil	Nil	26	36	46	47
1-10-85	Nil	2	Nil	Nil	Nil	Nil	Nil	Nil	17	9	97	210
Total	243	514	3	1	1	1	-	-	274	143	796	782
Mean	17.36	36.71	0.21	0.07	0.07	0.07	-	-	19.57	10.21	56.85	55.85
Range	0-69	1-105	0-2	0-1	0-1	0-1	-	-	6-52	2-36	14-98	15-210

(a) = incubated at 37°C for 48 hours (b) = incubated at 37°C for 20-24 hours
(c) = incubated at 55°C for 48 hours (d) = incubated at 5°C for 7 days

Table 12. Bacteriological quality of aseptically-drawn milk samples from Goat No.6279

Date of collection	Standard plate count/ml (a)		Coliform count/ml (b)		Thermophilic count/ml (c)		Psychrophilic count/ml (d)		Methylene blue reduction time (in hours)		Keeping quality at room temperature (28°C) in hours	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
27-3-85	63	25	1	Nil	Nil	Nil	Nil	Nil	15	8	96	72
12-4-85	28	17	Nil	Nil	Nil	Nil	Nil	Nil	10	8	48	56
24-4-85	12	9	2	1	Nil	Nil	Nil	Nil	8	6	98	80
9-5-85	5020	665	2	2	1	Nil	Nil	Nil	0.5	8	78	61
23-5-85	20075	11275	2	Nil	Nil	Nil	Nil	Nil	6	6	22	27
6-6-85	310	16	Nil	Nil	Nil	Nil	Nil	Nil	8	2	28	38
17-6-85	8	2	Nil	Nil	Nil	Nil	Nil	Nil	8	9	24	17
3-7-85	8	7	1	Nil	Nil	Nil	Nil	Nil	12	3	58	28
16-7-85	170	27	Nil	Nil	Nil	Nil	Nil	Nil	10	1	30	28
5-8-85	112	29	Nil	Nil	Nil	Nil	Nil	Nil	9	2	28	28
19-8-85	2	2	Nil	Nil	Nil	Nil	Nil	Nil	52	2	101	90
4-9-85	3	1	Nil	Nil	Nil	Nil	Nil	Nil	2	0.5	44	29
17-9-85	3	3	Nil	Nil	Nil	Nil	Nil	Nil	5	1	120	40
1-10-85	5	Nil	Nil	Nil	Nil	Nil	Nil	Nil	14	1	68	91
Total	25819	12078	8	3	1	-	-	-	159.5	57.5	843	685
Mean	1844.21	862.71	0.57	0.21	0.07	-	-	-	11.39	4.11	60.21	48.93
Range	2-20075	1-11275	0-2	0-2	0-1	-	-	-	0.5-52	0.5-9	28-120	28-91

(a) = incubated at 37°C for 48 hours (b) = incubated at 37°C for 20-24 hours
(c) = incubated at 55°C for 48 hours (d) = incubated at 5°C for 7 days

Table 13. Bacteriological quality of aseptically-drawn milk samples from Goat No.916

Date of collection	Standard plate count/ml (a)		Coliform count/ml (b)		Thermophilic count/ml (c)		Psychrophilic count/ml (d)		Methylene blue reduction time (in hours)		Keeping quality at room temperature (28°C) in hours	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
9-4-85	505	560	Nil	Nil	Nil	Nil	Nil	Nil	12	8	72	68
24-4-85	93	171	Nil	Nil	Nil	Nil	Nil	Nil	11	10	98	120
9-5-85	3365	55	Nil	Nil	Nil	Nil	Nil	Nil	9	10	72	60
23-5-85	2830	53	Nil	Nil	Nil	Nil	Nil	Nil	8	15	20	19
6-6-85	2700	330	Nil	Nil	Nil	Nil	Nil	Nil	11	4	28	22
17-6-85	1250	550	Nil	Nil	Nil	Nil	Nil	Nil	12	17	48	19
3-7-85	5250	3500	3	Nil	Nil	Nil	Nil	Nil	9	3	36	23
16-7-85	9250	9600	1	Nil	Nil	Nil	Nil	Nil	7	5	13	10
5-8-85	5500	1625	Nil	Nil	Nil	Nil	Nil	Nil	8	3	26	29
19-8-85	11200	2250	Nil	Nil	Nil	Nil	Nil	Nil	3	3	55	19
Total	41943	18694	4	-	-	-	-	-	90	78	468	389
Mean	4194.30	1869.40	0.40	-	-	-	-	-	9	7.8	46.8	38.9
Range	93-11200	53-9600	1-3	-	-	-	-	-	3-12	3-17	13-98	10-120

(a) = incubated at 37°C for 48 hours
(b) = incubated at 37°C for 20-24 hours
(c) = incubated at 55°C for 48 hours
(d) = incubated at 5°C for 7 days

Table 14. Bacteriological quality of aseptically-drawn milk samples from Goat No.6636

Date of collection	Standard plate count/ml (a)		Coliform count/ml (b)		Thermophilic count/ml (c)		Psychrophilic count/ml (d)		Methylene blue reduction time (in hours)		Keeping quality at room temperature (28°C) in hours	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
9-4-85	18	62	Nil	1	1	Nil	Nil	Nil	12	1	120	96
24-4-85	25	1	Nil	Nil	1	1	Nil	Nil	15	8	48	48
9-5-85	10	16	Nil	Nil	Nil	Nil	Nil	Nil	9	8	101	96
23-5-85	17	87	Nil	Nil	Nil	Nil	Nil	Nil	8	6	32	25
6-6-85	62	6	Nil	Nil	Nil	Nil	Nil	Nil	18	16	25	18
17-6-85	56	22	Nil	Nil	Nil	Nil	Nil	Nil	10	8	17	19
3-7-85	25	11	Nil	Nil	Nil	Nil	Nil	Nil	9	10	27	18
16-7-85	72	59	Nil	Nil	Nil	Nil	Nil	Nil	9	6	16	22
5-8-85	37	49	Nil	Nil	Nil	Nil	Nil	Nil	23	8	16	19
19-8-85	2	4	Nil	Nil	Nil	Nil	Nil	Nil	21	10	23	40
4-9-85	38	4	Nil	Nil	Nil	Nil	Nil	Nil	22	9	24	17
17-9-85	2	1	Nil	Nil	Nil	Nil	Nil	Nil	20	19	87	47
1-10-85	2	1	Nil	Nil	Nil	Nil	Nil	Nil	11	10	36	66
15-10-85	3	2	Nil	Nil	Nil	Nil	Nil	Nil	54	10	102	30
Total	369	325	-	1	2	1	-	-	240	129	674	561
Mean	26.36	23.21	-	0.07	0.14	0.07	-	-	17.14	9.21	48.14	40.07
Range	2-72	1-87	-	0-1	0-1	0-1	-	-	8-54	1-19	16-120	18-96

(a) = incubated at 37°C for 48 hours (b) = incubated at 37°C for 20-24 hours
(c) = incubated at 55°C for 48 hours (d) = incubated at 5°C for 7 days

Table 15. Bacteriological quality of aseptically-drawn milk samples from Coat No.6731

Date of collection	Standard plate count/ml (a)		Coliform count/ml (b)		Thermophilic count/ml (c)		Psychrophilic count/ml (d)		Methylene blue reduction time (in hours)		Keeping quality at room temperature (28°C) in hours	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
9-4-85	2455	885	Nil	Nil	Nil	Nil	Nil	Nil	11	4	150	98
24-4-85	1055	760	1	1	1	1	Nil	Nil	4	4	96	80
9-5-85	38	1250	Nil	Nil	1	Nil	Nil	Nil	10	8	72	48
23-5-85	1700	10200	Nil	Nil	Nil	Nil	Nil	Nil	16	6	18	15
6-6-85	12525	4750	Nil	Nil	Nil	Nil	Nil	Nil	13	4	9	3
17-6-85	5550	3150	Nil	Nil	Nil	Nil	Nil	Nil	10	7	26	21
3-7-85	7800	3750	Nil	Nil	Nil	Nil	Nil	Nil	11	6	23	23
16-7-85	14350	2055	Nil	Nil	Nil	Nil	Nil	Nil	14	3	26	24
5-8-85	9850	176	Nil	Nil	Nil	Nil	Nil	Nil	9	2	53	19
19-8-85	25350	1380	Nil	Nil	Nil	Nil	Nil	Nil	13	20	21	40
4-9-85	118	170	Nil	Nil	Nil	Nil	Nil	Nil	10	13	20	101
17-9-85	10950	1700	Nil	Nil	Nil	Nil	Nil	Nil	20	19	87	47
1-10-85	7200	845	Nil	Nil	Nil	Nil	Nil	Nil	18	13	102	77
15-10-85	10250	750	Nil	Nil	Nil	Nil	Nil	Nil	18	11	80	30
Total	109191	31821	1	1	2	1	-	-	177	120	783	626
Mean	7799.36	2272.93	0.07	0.07	0.14	0.07	-	-	12.64	8.57	55.93	14.71
Range	38-25350	176-10200	0-1	0-1	0-1	0-1	-	-	4-20	2-20	9-150	3-101

(a) = incubated at 37°C for 48 hours (b) = incubated at 37°C for 20-24 hours
(c) = incubated at 55°C for 48 hours (d) = incubated at 5°C for 7 days

Table 17. Bacteriological quality of pooled milk samples produced at ...C.R.P. on Goats for Milk

Date of collection	Standard plate count/ml ($\times 10^3$) (a)		Coliform count/ml ($\times 10^2$) (b)		Thermophilic count/ml (c)		Psyc co	ilic ml	Methylene blue reduction time (in hours) at 37°C in incubating bath		Keeping quality at room temperature (28°C) in hours		Correlation	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morni mil	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
17-3-85	187	62	85	47	Nil	Nil	Nil	Nil	4	4	12	11	Standard plate count vs keeping quality = -0.46 (significant)	Standard plate count vs keeping quality = +0.24 (not significant)
18-3-85	475	87	172	7	Nil	1	Nil	Nil	4	4	12	12		
27-3-85	64	172	3	10	Nil	Nil	Nil	Nil	6	3	15	12		
3-4-85	115	138	10	10	1	Nil	Nil	Nil	2	6	13	12		
9-4-85	27	14	10	8	Nil	Nil	Nil	Nil	5	5	14	12		
12-4-85	21	35	16	4	1	1	Nil	Nil	5	5	13	13		
18-4-85	33	181	11	10	2	2	Nil	Nil	5	3	15	13		
24-4-85	45	137	5	9	1	1	Nil	Nil	5	5	14	14	Methylene blue reduction time vs keeping quality = + 0.31 (not significant)	Methylene blue reduction time vs keeping quality = +0.13 (not significant)
3-5-85	70	40	0.2	1.3	1	1	Nil	Nil	5	3	12	12		
9-5-85	85	122	0.7	0.6	3	2	Nil	Nil	4	4	13	12		
14-5-85	316	365	53	70	Nil	Nil	Nil	Nil	5	4	12	10		
23-5-85	65	174	8	11	Nil	1	Nil	Nil	5	4	11	10		
31-5-85	55	120	7	8	1	1	Nil	Nil	6	3	13	12		
6-6-85	184	173	96	81	1	Nil	Nil	Nil	4	3	11	11		
17-6-85	175	175	32	6	Nil	Nil	Nil	Nil	5	4	12	11		
3-7-85	174	290	33	3	1	Nil	Nil	Nil	4	4	12	14		
16-7-85	252	72	17	15	Nil	Nil	Nil	Nil	5	5	13	11		
5-8-85	36	35	32	5	Nil	Nil	Nil	Nil	5	3	13	12	Methylene blue reduction time vs Standard plate count = -0.21 (not significant)	Methylene blue reduction time vs standard plate count = -0.27 (Not significant)
19-8-85	54	34	7	5	Nil	Nil	Nil	Nil	4	4	14	15		
4-9-85	32	165	18	35	Nil	Nil	Nil	Nil	5	3	15	13		
17-9-85	103	160	68	31	Nil	Nil	Ni	Nil	4	4	12	12		
1-10-85	72	274	50	32	Nil	Nil	Nil	Nil	4	3	12	12		
15-10-85	39	211	51	220	Nil	Nil	Nil	Nil	4	2	13	11		
Total	2679	3236	784.9	628.9	12	10	-	-	105	88	296	277		
Mean	116.48	140.70	34.13	27.34	0.52	0.43	-	-	4.57	3.83	12.87	12.04		
Range	21-475	14-365	0.2-172	0.6-220	0-3	0-2	-	-	2-6	2-6	11-15	11-15		

(a) = incubated at 37°C for 48 hours (b) = ...bated at 37°C for 20-24 hours
(c) = incubated at 55°C for 48 hours (d) = ...bated at 5°C for 7 days

Table 16. Average values of different bacteriological tests for aseptically-drawn milk samples of experimental goats

Animal number	Standard plate count/ml		Coliform count/ml		Thermop count/	Psychrophilic count/ml		MBR time (in hours)		Keeping quality (in hours)	
	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	aning ilk	Morning milk	Evening milk	Morning milk	Evening milk	Morning milk	Evening milk
F_2A 266	25.79 (0-248)	100.50 (6-1250)	0.14 (0-1)	0.29 (0-3)	0.07 (0-1)	.07 0-1)	Nil	Nil	18.78 (0-58)	11.64 (0.5-25)	59 (20-27)	51.14 (20-101)
F_2A 209	19.14 (1-64)	22.14 (1-110)	0.14 (0-1)	Nil	Nil	.07 0-1)	Nil	Nil	30.07 (9-130)	11.32 (0.5-33)	35.36 (16-72)	29.50 (16-52)
F_2A 231	4689.69 (196-23875)	1788.08 (315-4070)	0.08 (0-1)	0.23 (0-3)	0.23 (0-1)	Nil	Nil	Nil	6.46 (1-11)	4.12 (0.5-8)	51.08 (9-96)	48.38 (3-96)
F_2A 72	22.29 (2-69)	33.21 (0-320)	0.36 (0-4)	0.07 (0-1)	Nil	Nil	Nil	Nil	17.86 (12-29)	15.07 (4-42)	44.43 (9-98)	49.57 (8-124)
F_2A 331	2045.43 (8-20800)	277.00 (4-1655)	0.14 (0-1)	0.07 (0-1)	0.4 (0-2)	.07 0-1)	Nil	Nil	8.54 (0.5-22)	5.71 (1-15)	39.00 (16-96)	45.71 (15-98)
F_2A 317	42.43 (1-242)	16.50 (0-47)	0.07 (0-1)	0.07 (0-1)	Nil	Nil	Nil	Nil	25.79 (9-120)	20.21 (2-68)	61.71 (18-150)	39.57 (15-120)
AAM 106	4037.29 (27-9900)	2678.50 (15-20100)	Nil	0.07 (0-1)	Nil	Nil	Nil	Nil	11.50 (5-18)	6.79 (0.5-15)	45.71 (18-108)	38.57 (21-96)
6318	2608.45 (10-10425)	435.18 (6-2250)	0.18 (0-1)	0.36 (0-2)	Nil	.09 0-1)	Nil	Nil	9.89 (2-29)	6.59 (0.5-17)	49.00 (18-96)	44.36 (19-96)
6721	18.64 (1-77)	6.43 (0-19)	0.07 (0-1)	Nil	0.21 (0-1)	.14 0-1)	Nil	Nil	10.21 (1-17)	3.64 (1-12)	53.36 (19-168)	50.50 (18-132)
6773	17.36 (0-69)	36.71 (1-105)	0.21 (0-2)	0.07 (0-1)	0.07 (0-1)	.07 0-1)	Nil	Nil	19.57 (6-52)	10.21 (2-36)	56.85 (14-98)	55.85 (15-210)
6279	1844.21 (2-20075)	862.71 (1-11275)	0.57 (0-2)	0.21 (0-2)	0.07 (0-1)	Nil	Nil	Nil	11.39 (0.5-52)	4.11 (0.5-9)	60.21 (28-120)	48.93 (28-91)
916	4194.30 (93-11200)	1869.40 (53-9600)	0.40 (1-3)	Nil	Nil	Nil	Nil	Nil	9 (3-12)	7.8 (3-17)	46.8 (13-98)	38.9 (10-120)
6636	26.36 (2-72)	23.21 (1-87)	Nil	0.07 (0-1)	0.14 (0-1)	0.07 (0-1)	Nil	Nil	17.14 (8-54)	9.21 (1-19)	48.14 (16-120)	40.07 (18-96)
6731	7799.36 (38-25350)	2272.93 (176-10200)	0.07 (0-1)	0.07 (0-1)	0.14 (0-1)	0.07 (0-1)	Nil	Nil	12.64 (4-20)	8.57 (3-20)	55.93 (9-150)	44.71 (3-101)
Total	27390.74	10422.50	2.43	1.50	1.07	0.65	-	-	208.78	124.99	706.67	625.76
General mean	1956.48	744.46	0.17	0.11	0.08	0.05	-	-	14.91	8.93	50.48	44.70

Note: Figures in parentheses indicate the range value

Table 18. Bacteriological quality of aseptically-drawn and farm pooled milk samples

Bacteriological tests	Time of milking	Aseptically drawn milk samples (per ml)				Farm pooled milk samples (per ml)			
		Number of samples	Minimum	Maximum	Average	Number of samples	Minimum	Maximum	Average
Standard plate count/ml	Morning	188	0	25350	1956.48	23	21×10^3	475×10^3	116.48×10^3
	Evening	188	0	20100	744.48	23	14×10^3	365×10^3	140.70×10^3
Coliform count/ml	Morning	188	0	4	0.17	23	0.2×10^2	172×10^2	34.13×10^2
	Evening	188	0	3	0.11	23	0.6×10^2	220×10^2	27.34×10^2
Thermophilic count/ml	Morning	188	0	2	0.08	23	0	3	0.52
	Evening	188	0	1	0.05	23	0	2	0.43
Psychrophilic count/ml	Morning	188	0	0	Nil	23	0	0	Nil
	Evening	188	0	0	Nil	23	0	0	Nil
Methylene blue reduction time (in hours)	Morning	188	0.5	130	14.91	23	2	6	4.57
	Evening	188	0.5	68	8.93	23	2	6	3.83
Keeping quality (in hours)	Morning	188	9	168	50.48	23	11	15	12.87
	Evening	188	3	210	44.70	23	11	15	12.04

Table 19. Distribution of standard plate counts of aseptically-drawn milk samples

Time of milking	Total number of samples	Standard plate count/ml			
		0-10 number	10-100 number	>100-1000 number	>1000-30000 number
Morning	180	49(26.06)	66(35.11)	19(10.11)	54(28.72)
Evening	180	68(36.17)	52(27.66)	35(18.62)	33(17.55)

Note: Figures in parentheses indicate the percentage value

Table 20. Distribution of standard plate counts of farm pooled milk samples

Time of milking	Total number of samples	Standard plate count/ml (x 10^3)		
		20-100 number(%)	>100-200 number(%)	> 200-500 number(%)
Morning	23	14(60.87)	6(26.09)	3(13.04)
Evening	23	8(34.78)	11(47.83)	4(17.39)

Table 21. Distribution of coliform counts of farm pooled milk samples

Time of milking	Total number of samples	Coliform count/ml (x 10^2)		
		0-10 number(%)	>10-100 number(%)	>100 number(%)
Morning	23	9(39.13)	13(56.52)	1(4.35)
Evening	23	14(60.87)	8(34.78)	1(4.35)

Table 22. Distribution of Methylene blue reduction time of aseptically-drawn milk samples

Time of milking	Total number of samples	Methylene blue reduction time (in hours)				
		0.5-5 number(%)	6-10 number(%)	11-20 number(%)	21-30 number(%)	>30 number(%)
Morning	188	23(12.23)	59(31.38)	73(38.83)	22(11.70)	11(5.85)
Evening	188	65(34.57)	77(40.96)	32(17.02)	8(4.26)	6(3.19)

Table 23. Grading of farm pooled milk samples by Methylene blue reduction test as per ISI

Time of milking	Total number of samples	Grades of pooled milk: Poor 0.5 hour number(%)	Fair 1 and 2 hours number(%)	Good 3 and 4 hours number(%)	Very good 5 hours and above
Morning	23	Nil	1 (4.35)	9 (39.13)	13 (56.52)
Evening	23	Nil	1 (4.35)	17 (73.91)	5 (21.74)

Table 24. Keeping quality of aseptically-drawn milk samples kept at room temperature (28°C)

Time of milking	Total number of samples	Clot-on-boiling test showing positive at: 1-10h number	11-20h number	21-30h number	31-40h number	41-50h number	51-60h number	61-70h number	71-80h number	81-90h number	91-100h number	>100 h number
Morning	188	4 (2.13)	26 (13.83)	47 (25.00)	16 (8.51)	16 (8.51)	18 (9.57)	7 (3.72)	21 (11.17)	8 (4.26)	14 (7.45)	11 (5.85)
Evening	188	4 (2.13)	42 (22.34)	40 (21.28)	26 (13.83)	20 (10.64)	10 (5.32)	9 (4.79)	13 (6.91)	1 (0.53)	13 (6.91)	10 (5.32)

Note: Figures in parentheses indicate the percentage

Table 25. Keeping quality of farm pooled milk samples kept at room temperature (28°C)

Time of milking	Total number of samples	Clot-on-boiling test showing positive at		
		10 and 11 hours number	12 and 13 hours number	14 and 15 hours number
Morning	23	2 (8.70)	15 (65.22)	6 (26.09)
Evening	23	7 (30.43)	13 (56.52)	3 (13.04)

Note: Figures in parentheses indicate the percentage

Discussion

5. DISCUSSION

As it was felt essential to have a comprehensive evaluation of goat milk for its bacteriological quality, the present study was undertaken with a view to gain informations about the types of bacteria which may be present and this may help to provide guidelines for the production of good quality goat milk.

5.1. Total bacterial count

The bacterial number in raw milk provides an indication of the sanitary conditions followed in the production and handling of milk. As there is no practical way of testing milk routinely for detection of pathogenic bacteria the use of total bacterial count as an indicator of the bacteriological quality of milk cannot be ruled out.

The standard plate count of aseptically-drawn milk sample of the experimental goats (Tables 2-15) varied greatly among individuals and between the morning and evening aseptically-drawn milk samples. The overall mean of SPC of aseptically-drawn milk samples in the morning was 1956.48 bacteria/ml and that of evening samples was 744.46/ml (Table 16). This difference in counts between morning and evening samples could be due to the difference in time interval between milkings. As the interval period of morning milkings (17 h) was more, the bacteria present

in the udder might multiplied to a higher number when compared to evening milk (7 h interval).

The average standard plate count of aseptically-drawn milk according to Singh et al. (1974) was 2,825/ml and there was more than 100-fold increase in bacterial number from aseptically-drawn milk to the production-end milk. The results of present study presented in Table 18 indicated that there was an increase over 59 and 188-fold in bacterial number from aseptically-drawn milk to the production-end milk for the morning and the evening milkings respectively. The high increase in bacterial number from aseptically-drawn milk to production-end milk was therefore mainly due to the sanitary conditions and handling of milk. However most of the samples of milk in this study were found to fall within 'very good' grade and few were of 'good' grade and none of the samples fell within grade of 'fair' or 'poor' grade as per the standards laid down in ISI for grading of milk based on bacterial counts.

In aseptically-drawn milk the count below 100 bacteria/ml was found in 61.17% and 64.83% of the samples for the morning and the evening milkings respectively (Table 19) and above 1000 bacteria/ml was in 28.72% of the morning and 17.55% of the evening samples respectively. Hunter (1984) who conducted the bacteriological analysis of aseptically-drawn milk from goats found that 80% of the samples contained

less than 100 bacteria/ml and 3.6% of the samples contained above 1000/ml. This difference in findings could be due to the influence of the conditions of the environment over the milk within the udder.

The bacterial counts of aseptically-drawn milk from 2 out of 14 goats were less than 100 bacteria/ml throughout their lactation period in both the morning and the evening samples whereas in one goat the samples had always a count of more than 100/ml (Table 16). This difference of bacterial content in the milk of one individual to another may be due to the differences in the size of the teat canal and incomplete and intermittent milkings.

Vries (1975) obtained the median bacterial count below 100/ml in 41% of quarter samples, 10^2-10^3 in 35%, 10^3-10^4 in 23% and above 10^4/ml in 1% of the aseptically-drawn quarter samples from several cows over a period of four months. According to Bacic et al. (1968) the arithmetic mean of the colony count of aseptically drawn milk was 3,403 bacteria/ml and the counts on total milk (fore milk + main milk) from individual cows showed a wide range of distribution while Gorino (1979) found that the total bacterial counts of 75 $\pm$ 17/ml on the aseptically-drawn milk from healthy Russian Black pied cows in their first lactation when they were tied up and housed on wooden floors without bedding and 135$\pm$33/ml when they were loose-housed in stalled floor

cubicles. Similar groups of cows in their 3rd-5th lactations had total bacterial counts of 1526 ± 212 and 1269 ± 290/ml respectively and the milk from cows giving a positive result with Dimastin anastitis test reagent contained higher total bacterial count of 29,078 ± 6095/ml. According to study conducted by Singh et al. (1974) the average standard plate count at production-end milk was 315,600/ml. Vijai and Saraswat (1968) found the average total count of milk from organised dairy farm to be 1,400,000/ml while the finding of Jain and Saraswat (1968) was 760,000/ml of milk from organised dairy farm.

However, in this study as seen in Table 17, the standard plate count of farm pooled milk at production-end was 116,480/ml with a range of 21,000-475,000/ml in the samples of morning milk and that of evening sample was 140,700/ml with a range of 14,000-365,000/ml. As compared to the standard plate count of cow milk within the country, the standard plate count of goat milk has been found to contain appreciably less bacteria/ml.

Jensen and Hughes (1980) showed that 38.8% of samples of raw milk of goats from retail outlets and farms exceeded the SPC limit of 10^5/ml. Similar finding was found in this study in the morning samples of pooled milk, the percentage being 39.13 while that of the evening milk was in 65.22% samples (Table 20). The higher bacterial count as seen in

the evening milk samples might be due to more dust in the stable air at evening hours and also due to the time interval between washing of utensils and its use at milking time. As goat milk is found to contain less bacteria in comparison to that of cow milk, a separate grading of goat milk may have to be established and this aspect merits further investigation.

5.2. Psychrophilic count

Although other workers obtained high count of psychrophilic bacteria in cow milk no psychrophilic bacterium was detected in the present study from any of the samples of aseptically-drawn milk or farm pooled milk of goats at production-end (Tables 16 and 17). This may be due to want of other time-temperature combination or want of preliminary incubation of higher temperature for initiation of the growth or due to the reason as given by Boyd et al. (1954) that the colony counting was difficult due to small colonies when incubated at 5°C for 7 days. Therefore the psychrophilic count of goat milk at other temperature-time combination or preliminary incubation if need be requires further investigation.

5.3. Thermophilic count

The thermophilic count of aseptically-drawn milk as well as farm pooled milk of goat at production-end was found

to be less than one as an average value in the present study (Tables 16 and 17). This result has in confirmity with the observations recorded by Desai et al. (1980) who in their study could not detect any thermophilic bacteria in the raw milk. However Randolph et al. (1973) obtained the mean thermophilic count of 41/ml from bulk tank trucks and Ethiraj et al. (1979) reported a thermophilic spore count of 43/ml in the samples of raw milk from organised dairy farms. It could be concluded that there seems to be no thermophilic bacteria in the aseptically-drawn milk of goat.

5.4. Coliform

It may be seen from the data presented in Tables 16 and 17 that the average coliform counts of aseptically-drawn milk of goats for both morning and evening milk samples was less than one and that of farm milk samples at production-end was 3,413 and 2,734/ml for morning and evening samples respectively.

Jensen and Hughes (1980) obtained a coliform count of 10/ml in 49.5% of the samples of raw milk of goats from retail outlets and farm. Hunter (1984) did not detect any coliform organisms in aseptically-drawn milk from goats. Similar variations in the coliform counts in cows milk have also been reported by other workers. Desai and Natarajan

(1981) found an average coliform count of 2,82,000/ml in the milk samples from milk producer's societies and Reddy et al. (1984) reported an average coliform count of 2,866/ml in raw milk samples from milk product Factory, Vijayawada (A.P.). Vijai and Sarasvat (1968) found the average coliform count of 320/ml for milk samples from organised dairy farm while Randolph et al. (1973) reported 1200 coliform/ml in milk samples of individual producers. Singh et al. (1974) obtained an average coliform count of 1310/ml of milk samples from production-end milk but no coliform was detected in aseptically-drawn milk.

As per the standards laid down in ISI the raw goat milk produced at the AICRP on Goat for Milk was found to be of low hygienic quality with regards to coliform count.

The results of the present study indicate that the contamination of the milk with coliforms was from the outside sources. It needs further investigation to find out the exact source of contamination.

5.5. Methylene blue reduction test

In the present study, the mean Methylene blue reduction time of aseptically-drawn milk was 14.91 h with an average keeping quality of 50.48 h for the morning samples and that of evening samples had an average MBR time of 8.93 h with a keeping quality of 44.70 h (Table 16). In farm pooled

milk samples the average MBR time was 4.57 h and a keeping quality of 12.87 h for the morning samples, 3.83 h and 12.04 h for the evening samples respectively (Table 18). The correlation coefficient between Methylene blue reduction time and keeping quality of farm pooled milk samples was +0.31 for the morning samples and +0.13 for evening samples which were found not significant. Slavchev (1979) found a moderate correlation between Methylene blue reduction time and total bacterial count (-0.50). However, the correlation between MBR time and standard plate count of farm pooled milk in this study was not found significant, the value being -0.21 for the morning samples and -0.27 for the evening samples (Table 17). This could be due to the various factors other than bacteria which may influence in reduction of dye. The present finding is in agreement with the conclusion drawn by Marutiram and Singh (1968) who stated that the reduction time did not give a precise estimate of the keeping quality particularly in the case of samples taken at production-end.

The pooled milk samples had an average MBR time of 4.57 h and 3.83 h with an average SPC of 116.48 x 10^3 and 140.70 x 10^3 in the morning and evening respectively (Table 18). The results of the study are not in agreement with the findings of Nader Filho et al. (1983) who found that the Methylene blue reduction time was compatible with

the bacterial count as measured by standard plate count (≤3.5 h for counts ≥500,000/ml). This difference in findings might be due to difference in species and composition of milk. The various factors other than bacteria seemed to have taken upper hand in the dye reduction in some of the aseptically-drawn milk samples as may be seen in Table 2-15. From the results obtained it was inferred that the Methylene blue reduction time did not correctly reflect the bacterial count in milk upto the production-end especially when the bacterial number in milk was low. The MBR test could be most applicable at later stages when the condition of sanitation in handling of milk became poorer.

5.6. Keeping quality

The clot-on-boiling test in the present study showed that the aseptically-drawn milk from the experimental goats had a mean keeping quality of 50.48 h for the morning and 44.70 h for the evening samples kept at room temperature (28°C) whereas in farm pooled milk samples it was 12.07 h for the morning and 12.04 h for the evening samples (Table 18). More or less similar findings have been reported for cow milk by Singh et al. (1974) who obtained a value of 44 h for aseptically-drawn milk and 13.5 h for production-end milk.

Mukundan et al. (1980) obtained 12 hours as the keeping

quality of raw milk stored at a temperature of 29°C. The data presented in Tables 24 and 25 revealed that the keeping quality of aseptically-drawn milk was more than 5) h in 42.02 and 29.78% of the morning and evening samples respectively. In the farm pooled milk 91.31% of the morning samples and 69.56% of the evening samples had a keeping quality of more than 12 h. This indicated that the morning milk samples as compared to evening samples had a better keeping quality for both aseptically-drawn milk and farm pooled milk.

The correlation coefficient between standard plate count and keeping quality of pooled milk was 0.46 for the morning samples thereby indicating a significant relationship. However the value obtained as +0.24 for the evening milk was not significant and therefore this could mean that there may be factors other than bacteria responsible in influencing the keeping quality of milk or the nature of bacteria causing spoilage of milk in the evening milk may be different from that in the morning milk.

Summary

SUMMARY

The present study was undertaken to have a comprehensive evaluation of goat milk for its bacteriological quality. A total of 376 aseptically-drawn milk and 46 farm pooled milk samples were collected from the All India Co-ordinated Research Project on Goats for Milk, Mannuthy, and subjected to bacteriological tests such as standard plate count (SPC), psychrophilic, thermophilic and coliform counts. Methylene blue reduction test and clot-on-boiling test were also carried out.

The SPC of aseptically-drawn milk samples varied greatly among individuals and also between the morning and evening milk samples. The overall mean of SPC in the morning samples was found to be 1956.48/ml and that of evening samples was 744.46/ml. The mean SPC of farm pooled milk samples at production-end was 116,480/ml for morning samples and 140,700/ml for evening samples. The result of the present study indicated that there was an increase of over 59 and 188-fold in bacterial numbers from aseptically-drawn milk to the production-end milk samples for the morning and the evening milkings respectively. However the milk produced in the farm was found to be of high quality as per the standards laid down by ISI in grading of milk based on SPC.

In aseptically-drawn milk the SPC below 100/ml was found in 61.17% and 64.83% of the morning and evening samples respectively and above 1000 bacteria/ml was noticed in 28.72% of the morning and 17.55% of the evening samples. In farm pooled milk samples a SPC above 10^5/ml was observed in 39.13% of the morning and 65.22% of the evening samples. The SPC of goat milk has been found to be appreciably low as compared to the SPC of cow milk within the country. The higher bacterial count in the evening milk samples might be due to more of dust in the stable air at evening hours and also due to the time interval between washing of the utensils and their use at milking time.

No psychrophilic bacterium was detected in the present study from any of the samples of aseptically-drawn milk or at production-end milk.

The mean thermophilic count of aseptically-drawn as well as farm pooled milk samples was found to be less than one/ml.

The mean coliform count of aseptically-drawn milk was found to be less than one/ml for both the morning and the evening samples. However the coliform counts of milk samples at production-end was 3,413 and 2,734/ml for the morning and the evening respectively. As per standards laid down by ISI, the milk produced at the AICRP on Goats for Milk, Mannuthy

was found to be of low hygienic quality based on the coliform count.

The mean Methylene blue reduction time (MBRT) of aseptically-drawn milk was 14.91 h with an average keeping quality of 50.48 h for the morning samples and the evening samples had an average MBRT of 8.93 h with a keeping quality of 44.70 h. In farm pooled milk samples the average MBR time was 4.57 h with a keeping quality of 12.87 h for the morning samples and the values were 3.83 h with 12.04 h respectively for the evening samples. The correlation coefficient between MBRT and keeping quality of farm pooled milk samples was +0.31 for the morning samples and +0.13 for evening samples and found to be not significant. The correlation coefficient between MBRT and standard plate count of farm pooled milk was also found not significant, the value being -0.21 for the morning samples and -0.27 for the evening samples.

The farm pooled milk samples showed an average MBRT of 4.57 and 3.83 h when the average SPC of the samples was 116.48×10^3 and 140.70×10^3 in the morning and evening respectively. From the results obtained, it was concluded that the MBRT did not correctly reflect the bacterial count in milk upto the production-end especially when the bacterial number in milk was low. The MBR test could be most applicable at later stages when the sanitary conditions in handling of milk became poorer.

The keeping quality of the milk samples kept at room temperature (28°C) was determined by clot-on-boiling test. The keeping quality of aseptically-drawn milk was found to be more than 50 h in 42.02 and 29.78% of the samples collected during the morning and the evening respectively. In the farm pooled milk 91.31% of the morning samples and 69.56% of the evening samples showed a keeping quality of more than 12 h. The morning milk samples as compared to evening samples had a better keeping quality for both aseptically-drawn milk as well as farm pooled milk.

The correlation between keeping quality and SPC of pooled milk samples collected in the morning was -0.46 which was of significant value while that of evening samples was not significant. The value for the samples of milk collected in the evening was +0.24 indicating that either the factors other than bacteria influence the keeping quality of evening milk or the nature of bacteria causing spoilage of milk in evening may be differenc from that in the morning milk.

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BACTERIOLOGICAL QUALITY OF GOAT MILK

By

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ABSTRACT OF A THESIS

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ABSTRACT

A total of 376 aseptically-drawn milk and 46 farm pooled milk samples were collected from the AICRP on Goats for Milk, Mannuthy and subjected to various tests to determine the bacteriological quality.

An increase of over 59 and 188-fold in bacterial number from aseptically-drawn milk to production-end milk for the morning and the evening milkings respectively was noticed.

In aseptically-drawn milk samples 61.17% and 64.83% gave a SPC of below 100/ml in the morning and evening respectively. In farm pooled milk samples the SPC exceeded 10^5/ml in 39.13% of the morning and 65.22% of the evening samples.

No psychrophilic bacteria was detected in any of the aseptically-drawn or farm pooled milk samples.

The mean thermophilic counts of aseptically-drawn as well as farm pooled milk samples was less than one/ml.

Though the mean coliform count of aseptically-drawn milk was found to be less than one/ml, the farm pooled milk samples showed 3,413 and 2734/ml for the morning and the evening samples respectively.

The mean MBRT of the morning and the evening samples

was 14.91 and 8.93 h for aseptically-drawn milk and 4.57 and 3.83 h for farm pooled milk samples respectively. The correlation coefficient between MBR time and SPC of farm pooled milk of the morning and evening samples was not significant (-0.21 and -0.27).

The keeping quality of the morning and the evening milk samples (28°C) obtained was respectively 50.48 and 44.70 h for aseptically-drawn milk and 12.87 and 12.04 h for farm pooled milk samples respectively.

The correlation coefficient between SPC and keeping quality of farm pooled milk samples was significant (-0.46) for morning sample while that of evening milk was not significant (+0.28).

The correlation coefficient between MBRT and keeping quality of farm pooled milk samples was also not significant in both the morning and the evening (+0.31 and +0.13).