STUDIES ON PHYSICO - CHEMICAL PROPERTIES AND INCIDENCE OF PATHOGENIC ORGANISMS IN VENDORS' MILK OF VARIOUS TAHESILS IN YEOTMAL DISTRICT

College of Dairy Technology, Warud (Pusatd)-445 204 India

ABSTRACT
Being number one country in milk production it is utmost important to see that the milk and dairy products produced in India meet the laid down/required national/international standards regarding the composition and microbiological qualities. The quality of milk vended in ten tahesils of Yeotmal district was investigated with the object to know the compositional parameters and incidence of pathogenic organisms therein. The results obtained on the fat content of vendors' milk showed statistically significant variation in its fat content. The protein content values were significantly different from each other. Moreover T. S. content of vendors' milk revealed the lowest value for Yeotrna1 tahesil to be 7.62 and the highest 9.84% with an average 8.53%. The acidity of vendors' milk was within the admissible limits. The average pH values of the vendors' milk tested for entire ten tahesils showed the highest pH during winter and the lowest values during summer. The electric conductivity of vendors' milk showed the average electric conductivity value of 104.82 mhos during the rainy season and 99.52 mhos in winter as well as 130.66 mhos in summer. The differences in specific gravity of milk samples during various seasons were found to be significant. In addition to this the presence of pathogenic/ enterotoxigenic organisms in vendors milk was alarming because though the milk was invariably boiled before its consumption their presence was an indication of unhygienic practices prevailing in milk production, handling and distribution.

INTRODUCTION
India has emerged as a premier/leading country in milk production, and as the Indian dairy industry is eyeing at the large export market, it will be utmost important to see that the Indian milk and dairy products for internal consumption as well as for export market meet the laid down/required national/international standards regarding the composition and microbiological qualities. Milk is perhaps the most complete source of naturally available food for man. Although, we have achieved tremendous improvement in milk production, the quality aspects have been the most neglected, leading to poor quality of milk and milk products. Moreover, we are to face a more open and liberal market, both domestic and abroad. With this changing scenario, we have to gear ourselves towards better quality of milk to meet the demands of market.

Yeotmal is one of the largest districts of Vidarbha region of Maharashtra inhaling many tribal communities. The rapidly increasing population of the district has resulted in an ever-increasing demand for milk. It has also increased the tendency of milk adulteration. Adulteration in milk and milk products is one of the most common problems of the Dairy Industry calling for an urgent solution. Milk may be a unique commodity, which can be very easily adulterated and marketed without the adulteration being detected in most of the cases.

The present work was undertaken with a view to assess the quality of milk marketed by vendors in various tahesils of Yeotmal district.

MATERIAL AND METHODS
The study was spread over three successive years, years viz. 1999-2000, 2000-2001 and 2001-2002 during summer, winter and rainy seasons. The investigation was planned to know the overall composition and chemical quality of vendor's milk. Incidence of pathogenic organisms like enterotoxigenic Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa and S. enterica Typhi was also tested.

* Shivaji College, Manora Distt. Washim(MS) India
Incidence of pathogenic organisms

The detection of Staph. aureus was done by a method described by ISO (1995), Salmonella typhi was detected by a procedure given by ISO (1985), E. coli was detected by a method described by ISI (IS: 1479-1977, Part-III), Pse. aeruginosa by the method described by Grover and Srinivasan (1988).

Chemical composition and Physico-chemical analysis

The milk samples were subjected to study its fat, protein, total solids (TS) and Solids-not-fat (SNF) content. Fat content in the milk was determined by the Gerber method as per Indian Standards (1977), the total protein content by Kjeldhal method (Indian Standards, 1961), the SNF and TS as per Indian Standards (1981).

The acidity of milk was determined as per BIS method (Indian Standards, 1960) and results were expressed as percent lactic acid (% LA). The electrode was immersed into the milk and the pH was recorded from the dial of the digital pH meter (Make: MACRO, Delhi, India). Electric conductivity of vendor's milk samples was measured by electric conductivity meter (Make: MACRO, Delhi, India) as per the manufacturer's instructions. The specific gravity is determined by using a lactometer method as per BIS Handbook, 1981 part-I. The data obtained on the physico-chemical properties and composition was statistically analyzed using Complete Randomized Design (CRD) and that on incidence pathogenic organisms by employing Randomized Block Design (RBD) (Snebedor and Cochran 1967.)

RESULTS AND DISCUSSION

Collection of vendor's milk samples

Samples were collected from vendors in ten tahesils of Yeotmal district of Vidarbha region namely Arnai, Babhulgaon, Darwha, Digras, Mahagoan, Pandharkawada, Pusad, Umarkhed, Wani, and Yeotmal. Forty samples were collected for three consecutive years during each of the three seasons from every tahsil. Samples were collected in sterile plastic glass bottles as per Indian Standards from the entry points of every tahsil at the rate of 250 ml per randomly selected vendor. The samples were then brought to laboratory crushed ice cooled containers. Fifty ml aliquots (for microbiological tests) were aseptically transferred in to sterile sample bottle and all the main samples (for physico-chemical analysis) and the aliquots were maintained in refrigerator till analysis.

RESULTS AND DISCUSSION

Chemical composition and Physico-chemical analysis

The results obtained on the fat content showed statistically significant variation. The highest average value obtained was 5.67% in Pandharkawada tahsil during the winter season while the lowest was observed in the Pusad tahsil (1.77%) during summer season. The graphic representation of this data is given in Fig.1. It could be seen from these graphs that the average fat content in the milk of ten different tahsilis is 3.48 for summer, 4.28 for winter and 3.77 for rainy season. This data indicates that the fat content is lowest during the lean season and highest during flush. The effect of season on fat percent of milk was found to be statistically significant. It was evident from the study that the fat content in winter season
was slightly higher than that of the standard prescribed for cow milk. The findings in this investigation are at par with those reported by Mishra et al. (1977). Tocher (1925) analyzed 676 milk samples from individual cow in Scotland over 14 months and Overman et al., (1939) analyzed 2426 composite samples from 147 cows of several breeds in the University of Illinois heard over several years and the data from these two studies indicated higher Coefficient of Variance (CV) for fat content. Similarly, analyses of nearly 900 samples from receiving station bulk tank in New York in 1959-1961 (Herrington et al., 1972) are also showing highest CV for fat. A survey (Gaunt, 1980) indicates change in the fat content of Friesians of 3.35-3.7% between 1933 and 1960 in the United States and 3.10-4.00% between 1900 and 1970 in the Netherlands.

The average values of the protein content (%) during winter, rainy and summer season for various tahasils are Ami (2.32, 2.16 and 2.13), Babhulgaon (2.92, 2.09 and 2.71), Darwha (2.19, 2.46 and 2.40), Digras (2.58, 2.62 and 2.31), Mahagaon (2.15, 2.23 and 2.58), Pandharkawada (3.09, 3.0 and 2.56), Pusad (3.15, 2.34 and 2.47), Umarkhed (2.36, 2.83 and 2.65), Wani (2.74, 2.71 and 3.2), and Yeotmal (2.54, 2.08 and 2.35). The graphic representation of this data is shown in Fig. 2. These values are significantly different from each other with a coefficient of variation ranging from 10.04 to 15.93. However, the differences between the protein content of the milk from season to season and year-to-year are non significant. The findings in the current investigation clearly indicate that the vendors’ milk sold in various tahasils of Yeotmal district do not meet the standard values probably due to adulteration of milk with water. These findings are strongly supported by earlier reports (Rook, 1961; Tocher, 1925). Tocher (1925) analyzed 676 milk samples from individual cow in Scotland over 14 months and Overman et al., (1939) analyzed 2426 3-day composite samples from 147 cows of several breeds in the University of Illinois herd over several years. The data from these two studies indicate higher CV for protein content. Similarly, analyses of nearly 900 samples from receiving station bulk tank in New York in 1959-1961 (Herrington et al., 1972) also showed highest CV for protein content.

The TS content (%) of milk of various tahasils is showing wide range i.e. Ami 7.72-8.99 (8.22), Babhulgaon 8.03-11.0 (9.45), Darwha 7.66-10.62 (8.98), Digras 5.47-10.71 (8.94), Mahagaon 8.69-10.00 (9.10), Pandharkawada 5.58-12.20 (9.21), Pusad-5.47-10.63 (7.82), Umarkhed 8.40-9.73 (9.11),
Results on the S.N.F. content of vendor's milk of various tahseils of Yeotmal district are graphically presented in Fig. 4. The average S.N.F. content in the milk obtained from various entry points of various tahseils during rainy, winter and summer were Ami: 4.84, 4.75 and 4.80; Babhulgaon: 5.04, 5.62 and 4.87; Darwaha: 5.21, 5.35 and 4.41; Digras: 4.73, 5.51 and 4.60; Mahagaon: 5.15, 5.20 and 4.97; Pandharkawada 5.10, 6.01 and 4.31; Pusad: 5.09, 5.02 and 3.65; Umarkhed: 5.34, 5.39 and 4.66; Wani: 4.76, 4.93 and 4.49; Yeotmal : 4.52, 5.58 and 4.63, respectively. The overall average values for the S.N.F. content of milk sold in various tahseils of Yeotmal district are 4.98, 5.34 and 4.55 during the rainy, winter and summer seasons, respectively. Results obtained in the present investigation are in agreement with earlier findings (Mishra et al., 1977).

The average acidity (% LA) of the vendors’ milk in Arni, Babhulgaon, Darwha Digras, Mahagaon, Pandharkawada, Pusad, Umarkhed, Wani and Yeotmal was 0.129, 0.123, 0.131, 0.130, 0.124, 0.123, 0.127, 0.125, 0.133, and 0.128 respectively. The average acidity values for entire ten tahseils are 0.128% (LA). The data is graphically represented in Fig. 5. These results are clearly indicative of the fact that the acidity of vendor’s milk is within the admissible limits. This might be due to adulteration of milk with neutralizers like sodium bicarbonate (Mathur et al., 1999).

The average pH values of vendor’s milk during rainy, winter and summer season for various tahseils were; Arni- 6.89, 6.92 and 6.79; Babhulgaon- 6.70, 6.97 and 6.39; Darwha- 6.62, 6.80 and 6.51; Digras- 6.74, 6.79 and 6.70; Mahagaon- 6.61, 6.95 and 6.61; Pandharkawda- 6.66, 6.77 and 6.58; Pusad- 6.76, 7.07 and 6.78; Umarkhed- 6.60, 6.69 and 6.45; Wani- 6.66, 6.69 and 6.52; Yeotmal- 6.62, 6.87 and 6.61, respectively. The overall average pH values of the vendors’ milk tested for entire ten tahseils shown the highest pH during winter to be 6.85 and the lowest values are recorded during summer to be 6.59. The graphical representation of the data is presented in Fig. 6. The statistical analysis of the data reveals that the pH of milk showed a great variation with a Coefficient of Variance.
The results of the present investigation on specific gravity of milk are presented in graphical form in Fig. 8. It is found that the lowest average values are reported in Pusad during summer (1.013) and the highest in rainy season (1.023). The average lowest and highest values in various tahesils are Arni (1.0146 and 1.0177), Babhulgaon (1.0148 and 1.0195), Darwha (1.0138 and 1.0191), Digras (1.0134 and 1.018), Mahagaon (1.0157 and 1.0196), Pandharkawda (1.0128 and 1.0227), Umakhed (1.015 and 1.0185), Wani (1.0138 and 1.062) and Yeotmal (1.0148 and 1.0191). The differences in specific gravity of milk samples during various seasons were found to
be significant. The significant effect of the years and seasons on specific gravity of milk was observed during this investigation. The samples collected from Pusad tahseil in rainy season showed highest specific gravity of 1.0232. Except this none of the samples were found to be at par with the standards prescribed by P.F.A. i.e. 1.029-1.032.

Ghosh and Chattoraj (1963) reported an outbreak of food poisoning due to consumption of milk product wherein 45 persons were involved. Malik (1968) reported outbreaks of food poisoning due to consumption of milk and isolated 169 strains of coagulase positive staphylococci. Reina, et al. (1998) also reported an outbreak due to enterotoxigenic Staph. aureus due to consumption of raw milk.

Incidence of pathogenic organisms

The results on incidence of enterotoxigenic Staph. aureus in the milk are presented graphically and given in Fig.9. The percentage of sample being positive for this organism during rainy, winter and summer season for various tahseils are as follow; 11.8, 3.33 and 4.25 for Arni; 12.55, 5 and 3.3 for Digras; 15.7, 2.5 and 4.25 for Mahagaon; 11.5, 7.5 and 3.3 for Pusad and 20, 4.15, 5.2 for Umarkhed respectively. The statistical analysis of the data shows a wide range of variation in the incidence of this organism in milk samples with coefficient of variation values of 4.98, 4.98, 3.46, 6.37, 3.46, 6.98, 3.31, 2.77, 8.73, and 4.98 in Arni, Babhulgaon, Darwa, Digras, Mahagaon, Pandharkawada, Pusad, Umarkhed, Wani and Yeotmal tahseils, respectively. Evans (1916) for the first time mentioned the occurrence of this enterotoxigenic organism in aseptically drawn milk from apparently healthy udders of cows.

The graphical representation of the data shown in Fig.10 on incidence of Sal. typhi in the milk concludes that 1.66% samples showed Sal. typhi during rainy and winter season and 2.5% in summer in Pusad tahseil. In Digras 5%, 0.8% and 1.66% samples showed presence of this organism during rainy, winter and summer seasons, respectively. In Umarkhed 2.5% samples were positive during rainy season, 1.66% in winter and 2.5% in summer. In Mahagaon tahseil 3.3% sample were positive in rainy season and 2.5% samples were positive in winter and summer season whereas in Arni 2.5% in rainy and winter and 1.66% in summer were positive for this organism. The statistical analysis of the data shows a wide range of variation in the incidence of this organism in milk samples with coefficient of variation values of 4.98, 9.68, 9.68, 22.47, 4.95, 8.47, 4.98, 6.98 and 4.98 in Arni, Babhulgaon, Darwa, Digras, Mahagaon,
Pandharkawada, Pusad, Umarkhed, Wani and Yeotmal tahesils respectively. Lecos (1986) reported a largest single salmonellosis outbreak in US history in 1985 where Salmonella-contaminated whole milk consumption was the reason of the outbreak in a suburban Chicago processor.

Incidence of *E. coli* in vendor's milk.

The results on incidence of *E. coli* in the milk are graphically represented in Fig. 11. It can be seen from the results that during rainy, winter and summer season about 14.8, 2.5 and 5 (Pusad), 13.3, 3.3 and 4.16 (Digras), 13.3, 6.66 and 5 (Umarkhed), 8.3, 4.16 and 4.16 (Mahagaon), 13.3, 7.5 and 5.83 (Arni) % samples showed *E. coli* respectively. The statistical analysis of the data shows a wide range of variation in the incidence of this organism in milk samples with coefficient of variation values of 16.23, 15.73, 9.27, 51.92, 14.74, 11.08, 17.78, 12.60, 20.37 and 10.24 in Pusad, Digras, Umarkhed, Mahagaon, Arni, Darwha, Yeotmal, Babhulgaon, Pandharkawada and Wani tahesils, respectively. Data also intensifies that the extent of this pathogen in milk was highest (23.3%) in Pandharkawada tahesil during rainy season.

Incidence of *P. aeruginosa* in vendor's milk.

The graphical representation of the results on incidence of *Ps. aeruginosa* in the milk samples data is given in Fig. 12. It can be concluded that 2.5% samples showed *Ps. aeruginosa* during all the three seasons in Pusad tahesil. In Digras 3.3%, 2.5% and 1.66% samples showed presence of this organism during rainy, winter and summer seasons, respectively. In Umarkhed 2.5% samples were positive for these rod shaped organisms during rainy season, 1.66% in winter and 2.5% in summer showed presence of this pathogenic organism responsible for several diseases. In Mahagaon tahesil 2.5% in rainy season, 1.66% in winter and 2.5% samples in summer showed presence of this organism whereas in Arni 2.5% in rainy, 1.66% in winter 2.5% in summer were positive for this organism. The statistical analysis of the data shows a wide range of variation in the incidence of this organism in milk samples with coefficient of variation values of 12.34, 14.63, 8.47, 34.28, 19.11, 58.40, 38.12, 56.22, 24.17 and 11.71 in Arni, Babhulgaon, Darwha, Digras, Mahagaon, Pandharkawada, Pusad, Umarkhed, Wani and Yeotmal, tahesils, respectively.
CONCLUSION

The quality of vendors' milk sold in ten tahesils of Yeotmal district was investigated with the object to know the compositional parameters and incidence of pathogenic organisms therein. The results obtained on the fat content of vendor's milk from different tahesils of Yeotmal district showed statistically highly significant variation in its fat content. The effect of season on fat percent of milk was found to be statistically significant. Results on the protein content of vendor's milk are significantly different from each other with a coefficient of variation ranging from 10.04 to 15.93. The vendor's milk sold in various tahesils of Yeotmal district do not meet the standard values probably due to adulteration of milk with water. It was observed that T. S. content of vendor's milk revealed the lowest value for Yeotmal tahesil to be 7.62 and the highest 9.84% with an average 8.53%.

It is concluded from this investigation that the presence of pathogenic/enterotoxigenic organisms in vendor's milk is alarming in the context of WTO/GATT era because though the milk is invariably boiled before its consumption throughout India, presence of these organisms is an indication of unhygienic practices prevailing in milk production. To maintain the highest standards of bacteriological quality to milk, the present system of payment, which is based on fat and SNF, needs to be changed to incorporate the payment based on bacteriological quality. This will ensure that the raw milk of highest bacteriological quality is available for production of milk products that meet international standards. In order to produce milk products conforming to international quality standards, it is important that the milk is collected, transported and cooled immediately under strict hygienic conditions. Ideally, all the milk reaching to the dairies should be bulk cooled.

REFERENCES

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