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Quality analysis of milk and milk products collected from Jalandhar, Punjab, India

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Abstract

The quality of branded and local dairy milk and milk products in Jalandhar, India with reference to their microbiological quality and, physical and chemical quality was checked. A total of 11 milk and milk product samples were collected and subjected to various tests for checking their microbiological, physical and chemical quality. It was observed that pasteurized milk samples showed slightly better quality than raw milk samples in terms of microbiological quality, indicating good handling practices and poor maintenance of sanitary quality of milk while milking/handling/storage, etc., of the raw milk samples. The butter samples were of slightly better bacteriological quality as compared to milk samples, probably because of presence of lesser moisture content and/or better processing practices. All the samples tested negative for the presence of coliforms and mastitis. The physical and chemical quality of milk and milk products was also good and only a single butter sample (B2) tested positive for the presence of vanaspati oil and starch. The current study yielded information about the quality of milk and milk products in Jalandhar, Punjab, India and the data is important keeping in mind the significance of sanitary quality of milk and milk products and its influence on health of the public.

Key words: Milk, Butter, Milk Powder, MBRT, SPC, Milk adulteration, Coliforms, Mastitis

Introduction

Milk is considered as one of the most important part of our diet as it is rich in nutrients. The high content of nutrients also makes it an excellent growth medium for microorganism (Chatterjee et al. 2006). Milk drawn from a healthy animal contains several hundred to several thousand microorganisms (Singh, 2008). The usage of contaminated water, containers, handling and variable temperature conditions may contaminate the milk with pathogenic microorganisms that are capable of degrading casein, lactose and milk fat (Chatterjee et al. 2006). The introduction of a few pathogens into milk becomes a much more serious problem because of the ability of these substances to support tremendous increases in bacterial numbers.

Many milk-borne epidemics of human diseases such as tuberculosis, typhoid, diphtheria, dysentery, etc., have been spread by contamination of milk by hands of dairy workers, unsanitary utensils, flies and polluted water supplies (Singh, 2008, Kumar et al., 2011).

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The bacterial count of milk indicates its sanitary quality and various methods are used for determining the bacterial count (Collins et al., 1995). Tests like, the standard plate count (SPC), determines the total number of bacteria in a sample that can grow and form countable colonies when incubated aerobically at 320C for 48 hours (Bashir and Usman, 2008). Generally SPC values for raw milk according to Bramley et al., (1984) that counts greater than 105cfu/ml are indicative of serious faults in production hygiene (Bashir and Usman, 2008). The coliforms can utilize various carbohydrates and other organic compounds for energy. Similarly, they can utilize nitrogen from a number of nitrogenous substances (Singh, 2008). The presence of fecal coliforms in milk indicates unsuitability of milk for drinking (Chatterjee et al. 2006). Similarly, methylene blue reductase test (MBRT) is also indicative of the microbial quality of milk (Nandy and Venkatesh, 2010). Microbial contamination of raw milk actually occurs after raw milk leaves the udder of healthy cows it contains very low numbers of micro organisms (Kurzweil and Busse, 1973). Cows affected with mastitis might shed large numbers of micro organisms into the milk (Bramley et al., (1984, Wegner and Stull, 1978). The physical and chemical

quality of milk and milk products (Kumar et al., 2011) is also of major concern as the quality of milk and milk products is hardly maintained by the time they reach the consumer level. Thus, a check on the addition of adulterants in milk and milk products is also needed. Keeping this in view, the present study was undertaken to evaluate the quality of market milk and milk products collected from different marketing sources at Jalandhar, one of the most developed regions of Punjab, India.

Materials and Methods

The chemical reagents used were of analytical grade and were procured from reputed companies

Collection of milk and milk products. Raw and pasteurized milk samples were collected from milk shops, milk vendors and milk societies from various locations of Jalandhar, Punjab, India, in sterile screw capped bottles and processed for various testing within 6 hours of collection during the period from August to October 2010. Similarly, milk powder and butter samples were collected from local milk shops of Jalandhar, Punjab, India during the above mentioned duration. The market packaged milk powder and butter samples were stored respectively at room temperature and under refrigerated (4oC) conditions for further use.

Microbiological quality of milk. Standard Plate Count (SPC). Standard plate count was used to determine total aerobic colony count for various samples of milk and milk products (milk powder and butter). A series of dilutions of the samples (10-1, 10-2, 10-3, 10-4, 10-5, 10-6) were prepared and 1ml of each dilution was mixed with nutrient agar media in Petri dishes. After incubation at 37oC for 48 hours, the colonies were counted by digital colony counter (Cappuccino and Sherman, 1996, Aneja, 2003).

Test for Coliforms. The milk and butter samples were tested for the presence of coliforms as per standard methods (Cappuccino and Sherman, 1996, Aneja, 2003).

Methylene Blue Reduction Test (MBRT). The milk and milk powder samples were graded on the basis of methylene blue reduction test (Table 1) by adding 1 ml of methylene blue solution to sterile test tubes containing 10 ml of each milk and milk powder sample and incubating the samples in a water bath at 37oC. The tubes were observed at an interval of 30 mins upto 7 hours of incubation (Cappuccino and Sherman, 1996, Aneja, 2003).

Detection of Mastitis. First two streams of fresh milk were taken into sterile test tubes and 1 ml bromothymol blue indicator was added to each sample. The tubes were shaken well for 5 to 10 minutes and observed for color change (Aneja, 2003).

Test for adulterants. Formalin Detection by Hehnes Test. Formalin (40%) can preserve milk for a long time but is poisonous. 10 ml of milk of each milk sample was taken in sterile test tubes, to which 0.5 ml of 1% ferric chloride and subsequently 5ml of concentrated sulphuric acid was added. The milk samples were observed for colored ring formation without shaking (Vishweshwar and Krishnaiah, 2005, Anonymous, 2005).

Test for the presence of skimmed milk. 10 ml of each milk sample was centrifuged at 3000 rpm for 30 minutes. 2.5 ml of HNO3, followed by 5 ml of H2O, was added to the pellet. 2.5 ml of liquid ammonia was then added to each sample and the samples were observed for the development of orange color (Vishweshwar and Krishnaiah, 2005, Anonymous, 2005).

Test for the presence of the cane sugar. 1 ml of concentrated HCL was added to each 10 ml of milk sample. 0.1 g Resorcinol powder was added and test tubes were placed in boiling water and analyzed the color appear (Vishweshwar and Krishnaiah, 2005, Anonymous, 2005).

Test for vanaspati (vegetable oil) in butter: A teaspoonful of butter sample was melted in a test tube and treated with 2 ml of conc. Hydrochloric acid. A pinch of cane sugar was then added to it. The tubes were shaken well for 1 min and kept aside for 5 min (Vishweshwar and Krishnaiah, 2005, Anonymous, 2005).

Test for starch in butter.A teaspoonful of butter sample was melted in a test tube and a few drops of iodine solution were added to it. Subsequently, all the sample tubes were observed for the appearance of blue colour (Vishweshwar and Krishnaiah, 2005, Anonymous, 2005).

RESULTS AND DICUSSION

Microbiological quality of milk. The microbial count, as indicated by SPC (Table 1), was highest (66*106 cfu/ml) for sample M2 (Pasteurized milk 2). The rest of the milk samples can be arranged in the following descending order of microbial count: M3 (27*106 cfu/ml) > M6 (66*108 cfu/ml) > M4 (18*106 cfu/ml) > M1 (36*106 cfu/ml) > M5 (55.1*109 cfu/ml). The results indicated that raw milk sample, M5, was of the best quality in terms of lowest bacterial load. Significantly higher bacterial load in pasteurized milk samples, as compared to raw milk sample (M5) indicates poor sanitary conditions that might be prevalent during the processing of the concerned milk samples or during handling of the concerned samples while working under laboratory conditions. But, as standard deviation nullifies the deviations observed for the results, the probability of occurrence of bacterial contamination in pasteurized milk samples is quite less. Also, the storage conditions, duration of storage and the place of storage of pasteurized milk samples under refrigerated conditions is also a crucial factor. Bacteria can grow readily at refrigeration temperatures too (Jansen, 2003, Leus et al., 2010).

The occurrence of lower bacterial load in pasteurized milk samples have been reported by Chatterjee et al., 2006. The butter samples, B2 (22*108 cfu/ml) and B3 (11.8*108 cfu/ml) reported lesser bacterial count as compared to sample B1 (17*108 cfu/ml) and even lesser bacterial count as compared to all the milk samples tested. This may be due to presence of lesser moisture and/or salt as preservative

(samples B1 and B2). The external sources such as, utensils, stable air, coat of animals and the milkers can add bacteria to milk (Hobbs and Gilbert, 1978, Qureshi, 1972). The emphasis has been put on reduction of contamination of milk by usage of clean milking utensils, equipments, washing udders before milking and keeping the cows animals in clean environment (Wallen et al., 1984), and the significance of cleaning individual teats with disinfected udder clothes has also been described (Islam et al., 1992)

As reported in Table 2, the raw milk sample, M5, detected positive for the presence of coliforms, while all the other samples, including, pasteurized milk (M1 to M4), raw milk (M6) and butter samples (B1 to B3) were negative for coliform test. The presence of coliforms in raw milk sample indicated insufficient hygiene at milking (Aggad et al. 2010) or during collection.

As reported in Table 3, MBRT performed for milk samples, reveals that milk sample M3 and M4 did not show any reduction in blue color even after 400 mins of incubation period, while milk samples 1 and 2 were of good quality. The raw milk samples (M5 and 6) were of fair quality as after 200 mins, the color of methylene blue begins to get reduced. The relatively lesser quality of raw milk samples as compared to the pasteurized ones simply indicate the effectiveness of pasteurization in improving the keeping quality of milk. Similar observations were made by others researchers as well (Chatterjee et al., 2006). The raw milk contained higher number of microflora probably due to contamination from the animal. Bacteria found in manure, soil and water may enter milk due to dairy utensils and milk contact surfaces. Such contamination can be reduced by clipping the cow and washing the udder with water or a germicidal solution before milking. Contamination of cow with manure, soil and water may also be reduced by paving and draining barnyards, keeping cows from stagnant pools and cleaning manure from the barns or milking parlours (Lues et al., 2010).

The raw milk samples (M5 and M6) tested negative for mastitis, as indicated by the appearance of brown color in the milk samples (Table 4). A large number of microorganisms might be present in the milk of cow infected with mastitis. Also, the microbial count, owing to mastitis, can be influenced by a number of factors like, microbial strains, the stage of infection or the percentage of the herd that is infected (Murphy and Boor, 2000).

Test for adulterants. As reported in Table 5a, all the pasteurized milk samples tested negative for the presence of formalin, as indicated by the absence of violet/blue ring at the intersection of the two layers. As the absence of orange color and the presence of yellow color in milk samples on dropwise addition of nitric indicated (Table 5b), all the pasteurized milk samples tested negative for the presence of skimmed milk. The skimmed milk is rich in protein content so nitric acid denatures the protein, which further reacts with ammonia to give orange color. Cane sugar is added to increase the Lactometer reading after addition of water. Hydrolysis of sucrose to glucose is checked by addition of resorcinol to the milk samples. Resorcinol produces red color solution with sucrose in acidic media. As reported in Table 5c, all the milk samples tested were found to be negative for the presence of the cane sugar.

The sample B2 of butter tested positive for the presence of vanaspati (vegetable oil) (Table 5d). The butter samples were tested for the presence of starch and it was observed that butter sample 2 indicated presence of starch while the other two samples (1 and 3) tested negative for presence of starch (Table 5e).

Conclusion

The results indicated that the microbiological quality of pasteurized milk samples was slightly better than raw milk samples as indicated by standard plate count. This indicating good handling practices that might have been exercised while handling of the milk samples. Similarly, a higher bacteriological count in case of raw milk samples is indicative of poor maintenance of sanitary quality of milk while milking/handling/storage, etc., of the raw milk samples. The butter samples were of slightly better bacteriological quality as compared to milk samples, probably because of presence of lesser moisture content. All the samples tested negative for the presence of coliforms and mastitis. The physical and chemical quality of milk and milk products was found to be good. Only a single butter sample (B2) tested positive for the presence of vanaspati oil and starch. The current study yielded significant information about the quality of milk and milk products in Jalandhar, Punjab, India.

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