RESEARCH ARTICLE

A STUDY ON AWARENESS REGARDING MILK BORNE DISEASES IN AN URBAN COMMUNITY OF KARNATAKA

Neeta PN[1], Prashanth N[2], Shivaswamy MS[3], Mallapur MD[3]
[1] Department of Community Medicine, Navodaya Medical College, Raichur, Karnataka, India
[2] Department of Anaesthesiology, Navodaya Medical College, Raichur, Karnataka, India
[3] Department of Community Medicine, JN Medical College, Belgaum, Karnataka, India

Correspondence to: Neeta PN (drnita10@gmail.com)

DOI: 10.5455/ijmsph.2014.190620144 Received Date: 04.06.2014 Accepted Date: 19.06.2014

ABSTRACT
Background: Milk is considered an attractive source of energy, proteins and calcium for infants and young children who have few alternative sources for these nutrients. Besides its beneficial effects on nutrition, milk is also ideally suited for growth of microorganisms. Many milk-borne epidemics of human diseases have been spread by contamination of milk by spoiled hands of dairy workers, unsanitary utensils, flies and polluted water supplies.
Aims & Objective: To assess knowledge and practices towards milk borne diseases.
Materials and Methods: A cross sectional study was conducted among 250 households residing in urban area, Belgaum district, using predesigned and pretested questionnaire. Informally marketed raw milk samples were collected from 10% households (25 houses) for laboratory analysis using Brucella milk ring test (BMRT), methylene blue reduction test (MBRT) and Coli form tests (CT) at the teaching hospital.
Results: None of the participants knew that diseases can be transmitted by milk or could name the milk borne diseases. 1/3rd of the participants revealed that they consume raw milk, among them 1/3rd quoted health and convenience as reason for consumption of raw milk. Upper and lower SES classes, milk consumption practices (of washing hands, washing utensils, adulteration with water) were studied. Among 25 samples collected for laboratory analysis, 3 (12%) samples were found positive for Brucella milk ring test and 5 (20%) samples were positive for methylene blue reduction test as well as Coliform test. Mean specific gravity was 1.026 ± 0.004.
Conclusion: Awareness about milk borne diseases was nil among participants. Attitude towards milk consumption practices was not satisfactory. One way to approach this problem would be to develop educational outreach programs for dairy producers, as well as for the general public, that focus on issues related to the consumption of raw milk.
Key Words: Raw Milk; Milk Borne Diseases; Coliform Test; Brucella Milk Ring Test

Introduction

Milk is an important dietary component of vast population on earth, due to its high nutritional value for human beings.[1] Being a nutritional, balanced foodstuff, milk is a well-known medium that favours the growth of several microorganisms.[2] However, milk is a natural food that has no protection from external contamination and can be contaminated easily, when it is separated from the cow.[3]

India keeps over three times the number of cattle as the USA. In addition, 94 million buffaloes contribute to milk production in India. It is estimated that around 15% of the milk produced in India is marketed through formal channels, while the remaining 85% is informally handled.[4] The informal milk market persists because it provides social and economic benefits to small scale producers, small market agents and consumers in terms of higher farm gate prices, creation of employment and competitive consumer prices.[5] Many of the poor Indian communities, who are staying in rural areas, are involved in milk production.[6] Milk is an excellent growth medium of organisms when suitable temperature exists[5,7], and it is prone to all types of microbiological contamination.[8]

Bacterial contamination of milk can generally occur at various stages viz. within the udder, outside the udder and from the surface of equipment used for milk handling and storage.[9] Many milk-borne epidemics of human diseases have been spread by contamination of milk by soiled hands of dairy workers, unsanitary utensils, flies and polluted water supplies.[1]

Risks of milk-borne zoonoses posed by the informal market are amplified by poor handling procedures in the market, the lack of quality standards and the fact that most consumers prefer raw milk over pasteurized milk.[2] Though India is located in tropical climate, sufficient cold chain and refrigeration facilities are not available in many parts of the country as these are very expensive for the rural people.[6]

As classified by the Joint FAO / WHO Expert Committee

(1970) on milk hygiene; the most important milk borne diseases transmitted from animals to humans are: brucellosis, tuberculosis, streptococcal/ staphylococcal infection, salmonellosis and Q fever. Diseases of less importance are - cow pox, foot and mouth disease, anthrax, leptospirosis and tick borne encephalitis. Infections transmitted through milk are - typhoid, paratyphoid fevers, shigellosis, cholera and entero-pathogenic E coli.[10]

A study from Ghana in 2007 had shown that informally marketed raw milk in the two cities could be an important source of infection with a wide range of organisms, particularly enteric pathogens. An important source of microbial contamination of the milk is fecal pollution probably from cow dung. It also emphasized the need for instituting effective control measures to protect public health. This includes mandatory milk pasteurization by traders and improved hygienic handling of the commodity during milking, ensuring milking is not done in presence of cow dung.[11]

A review assessing outbreaks of infection associated with milk and other dairy products in Europe and North America from 1980 to 1985 reported that, in 1984 an outbreak of brucellosis was reported in a village community of Italy.[12]

Another study reported that the presence of food borne pathogens in milk is due to direct contact with contaminated sources in the dairy farm environment and to excretion from the udder of an infected animal. Most milk is pasteurized; so why should be the dairy industry concerned about the microbial quality of bulk tank milk? There are several valid reasons, including[13];

- Outbreaks of disease in humans have been traced to the consumption of unpasteurized milk and have also been traced back to pasteurized milk.
- Unpasteurized milk is consumed directly by dairy producers, farm employees, and their families, neighbors, and raw milk advocates.
- Unpasteurized milk is consumed directly by a large segment of the population via consumption of several types of cheeses manufactured from unpasteurized milk.
- Entry of food borne pathogens via contaminated raw milk into dairy food processing plants can lead to persistence of these pathogens in bio-films, and subsequent contamination of processed milk products and exposure of consumers to pathogenic bacteria
- Pasteurization may not destroy all food borne pathogens in milk.
- Inadequate or faulty pasteurization will not destroy all food borne pathogens. Furthermore, pathogens such as Listeria monocytogenes can survive and thrive in post-pasteurization processing environments, thus leading to recontamination of dairy products.

These pathways pose a risk to the consumer from direct exposure to food borne pathogens present in unpasteurized dairy products as well as dairy products that become re-contaminated after pasteurization.[13]

Consuming raw (unpasteurized) milk could expose the public to many disease-causing organisms.[13] To protect public health against these milk borne diseases, there are regulations that require proper hygienic handling of milk and its pasteurization.[11]

Informal milk markets involve milk sale through unregulated channels. Such markets account for over 80% of convenient delivery and lower prices from this informal milk markets.[15] However, there are regulations such as restricting milk handling to cold chain pathways to discourage such markets for public health reasons, though these regulations are not generally implemented in many countries.[16-18]

A Survey in Pennsylvania done to assess foodborne pathogens in bulk tank milk and raw milk consumption among farm families showed that, 68.5% of the 248 dairy producers were aware of the fact that raw milk could contain disease-causing bacteria. Dairy producers who were not aware of foodborne pathogens in raw milk were 2-fold more likely to consume raw milk than producers who were aware of foodborne pathogens. 105 (42.3%) of the 248 dairy producers who participated in the BTM pathogen survey reported that they consumed raw milk. Dairy producers who consumed raw milk indicated that convenience (60%, availability of raw milk) and taste (72%) were the most important rationale. 61 (58.1%) of 105 reported that they continued to drink raw milk despite knowing that foodborne pathogens could be found in their raw BTM.[19]

There is limited data existing on raw milk consumption and corresponding risks of milk borne illnesses. It is a highly perishable commodity and poor handling can exert both a public health and economic toll – thus requiring hygienic vigilance throughout the production to consumer chain.[5]

Hence the present study focused to know the awareness of the urban community in Belgaum district, Karnataka, regarding milk borne diseases, and their attitude, practices towards the milk handling process.

Materials and Methods

The present study was conducted in urban catchment area of Dept. of community medicine, Jawaharlal Nehru Medical College (J.N.M.C); Belgaum district, Karnataka, South India. A total of 20% (250 households) of total households were selected by systematic random sampling to collect data by predesigned and pretested questionnaire from urban area. Of these 10% of households, i.e. 25 houses, using informally marketed milk were selected by simple random sampling and raw milk samples were collected for laboratory analysis. Written informed consent was obtained. Institutional Ethics Committee clearance was taken from J.N.M.C Belgaum, Karnataka.

A predesigned and pretested questionnaire assessing information regarding milk consumptions in terms of source, type, quantity (mL) and per capita consumption (mL) / day, knowledge about milk borne diseases, attributes that influence raw milk consumption practices, attitude (especially disease), consumption practice (hygiene of premises and personnel, adulteration), animal sources for milk (hygienic measures while milking) were assessed.

The information thus collected was computerized and analyzed by using Statistical Package for Social Science (SPSS 10.0) software program for Windows. Data was expressed in terms of rates, ratios and percentages. Laboratory reports were analyzed separately. Statistical analysis was done using Chi Square test and Fisher exact test. A probability value (p value) of less than 0.05 was considered as significant.

Milk samples were subjected to following tests:

(1) Physical test:

(a) *Specific gravity of milk by lactometer:* This was measured at the point of collection by the investigator using lactometer. Specific gravity of milk was measured using lactometer of Amber Company to detect the change in density of adulterated milk with water. Milk sample was gently poured into a measuring cylinder (50 mL). The lactometer was left to sink slowly into the milk. Measurement was read and recorded to the last Lactometer degree (ºL) (30) just above the surface of the milk. For the calculations, lactometer degrees were used, and for the conversion to density 1.0 was written in front of the true lactometer reading, that is, 1.030 g/mL. The average specific gravities considered were;

- Cow Milk - 1.028 to 1.030
- Buffalo Milk - 1.030 to 1.032
- Goat Milk - 1.028 to 1.030[5]

(2) Microbiological tests[8]:

(a) *Methylene blue reduction test to test presence of bacteria:* 10 ml of milk and 1ml of methylene blue solution was added to the 20ml of sterilized test tubes. Then tubes were closed with sterile rubber stopper, slowly tubes were inverted once or twice and then kept in water bath. Test was considered positive when whole column of milk was decolorized within 30minutes.

(b) *Coli form test to detect fecal contamination of milk:* Varying amounts of milk were added to tubes of bile salt lactose medium. For unknown quality of milk, the following series was suggested (1 ml of milk in 9 ml of MacConkey broth):

- 1.0 ml of a 1 in 10 dilution of milk;
- 1.0 ml of a 1 in 100 dilution of milk;
- 1.0 ml of a 1 in 1,000 dilution of milk;
- 1.0 ml of a 1 in 10,000 dilution of milk.

The smallest amount that yields acid and gas was ascertained. Under the Scottish regulations, for standard milk, these tubes were inoculated each with 1 ml of 1 in 1000 dilution. The milk sample was taken to have passed the test if acid and gas were absent from two of the three tubes. Samples were considered positive for coli form test, if showed more than 10^5 bacteria per ml of milk.

(c) *Brucella milk ring test:* The milk was mixed thoroughly and poured into a test tube sufficient to give a column of milk about 1 high. One drop of stained antigen was added and mixed thoroughly by shaking. Frothing was avoided which could interfere with reading of the test. It was incubated at 37^0 C water bath for about 40 to 50 minutes, which was sufficient time for the cream to rise. In milk containing Brucella agglutinins, the bacteria were agglutinated and raised with the cream forming a

blue cream line, having the skin milk-white in samples, in which there were no agglutinins. There was a white cream line and the rest of the milk remained blue. The results were interpreted as positive (+++). Cream layer formed a deep blue ring on top of a completely white column of milk. This indicated a high concentration of agglutinins. The white cream layer and milk column blue were considered as negative.

Results

This one year community based cross-sectional study surveyed 250 households consuming informally marketed milk about knowledge and practices about milk borne diseases and raw milk samples were collected from 10% of households (25 houses) for laboratory tests.

Majority of study participants (99.2%) responsible for handling of milk were females, and the age ranged from 19 to 67 years with mean age ± SD being 41.10 ± 14.09 years and median 41 years. Most of them belong to Hindu religion (72%). 134 out of 250 participants were from nuclear family, and 138 out of 250 participants were illiterates (figure 1). 40% belonged to class III socio economic status (SES) according to Modified B.G.Prasad's Classification.[10] Majority (98%) of study participants had BPL Ration Card. 1.6% participants had opted for life insurance in the year preceding the survey.

Half of the study participants preferred milk sources from milk vendors, 32.4% from dairy, 13.6% from animals from own house, 3.6% from both milk vendors and dairy. In the present study, none of the participants knew that diseases can be transmitted by milk or could name the milk borne diseases.

28% of participants had knowledge that milk can be contaminated, of which 8% quoted reason to be improper handling and unclean utensils. The milk consumption practices regarding washing hands and washing utensils before collection of milk, addition of water to milk and consumption of milk next day, was better in upper SES class than lower SES class in the study participants. This result was statistically significant. (Table 1)

1/3rd of the participants revealed that they consume raw milk, among them 1/3rd (30 participants) quoted health and convenience as the reason for consumption of raw milk.

Table-1: Association of socio-economic status with milk consumption practices (n=250)

Practices	SES Class	Yes		No	
		No	%	No	%
Washing hands before collection of milk	I	0	0	0	0
	II	50	20	0	0
	III	30	12	10	4.0
	IV	90	36	10	4.0
	V	60	24	0	0
	Total	**230**	**92**	**20**	**8.0**
	χ^2=25.815; p=0.000				
Washing utensil before collection of milk	I	0	0	0	0
	II	50	100	0	0
	III	40	100	0	0
	IV	90	90	10	10
	V	60	100	0	0
	Total	**240**	**96**	**10**	**4.0**
	χ^2=15.625; p=0.001				
Addition of water to milk	I	0	0	0	0
	II	20	40	30	60.0
	III	10	25	30	75.0
	IV	20	20	80	80.0
	V	30	50	30	50.0
	Total	**80**	**32**	**170**	**68.0**
	χ^2==17.923; p=0.000				
Consumption of milk next day	I	0	0	0	0
	II	0	0	50	100
	III	10	25	30	75
	IV	40	40	60	60
	V	0	0	60	100
	Total	**50**	**20**	**200**	**80**
	χ^2==53.125; p=0.000				
Covering milk utensil with lid	I	0	0	0	0
	II	50	20	0	0
	III	40	16	0	0
	IV	100	40	0	0
	V	60	24	0	0
	Total	**250**	**100**	**0**	**0**
	χ^2=0.45; p=0.796				

Table-2: Association of literacy with reasons for consumption of raw milk

Reasons	Illiterate		1-5th Std		6 – 10th Std		≥ 11th Std*		Total	
	N	%	N	%	N	%	N	%	N	%
Tastes good	8	10.0	2	2.5	0	0	0	0	10	12.5
Health purpose	7	8.7	3	3.7	0	0	0	0	10	12.5
Convenience	7	8.7	3	3.7	0	0	0	0	10	12.5
Taste and convenience	11	13.7	2	2.5	7	8.6	0	0	20	25.0
Health and convenience	17	21.2	9	11.2	2	2.5	2	2.5	30	37.5
Total	**50**	**62.5**	**19**	**23.7**	**9**	**11.2**	**2**	**2.5**	**80**	**100**
Significance	χ^2=2.702; p=0.609									

* 11th std + 12th std + Diploma and graduate

Table-3: Distribution of study participants according to animal sources of milk and place for animal keeping (n=250)

Milk Sources			N	%
Animals	Yes	Cow	20	8.00
		Buffalo	14	5.60
		Goat	0	0
		Buffalo & goat	0	0
		Total	**34**	**13.60**
	No		216	86.40
	Total		**250**	**100**
Place for animal keeping	Separate shed		21	8.40
	Within house		13	5.20

The literacy levels of study participants, when compared with knowledge about reasons for consumption of raw

milk, did not show any statistically significant results. More than 2/3rd of participants did not prefer to add water to milk after collection. Among the participants who prefer to add water, 20% of them added less than 50 mL. (Table 2)

Table-4: Distribution of study participants according to their practices of washing animals and cleaning the udder, washing utensil before milking (n=250)

Practices		Frequency	Urban	
			N	%
Washing animals	Yes	Daily	3	1.20
		Once in 2 days	11	4.40
		Once in 3 days	0	0
		> 3 days	20	8.00
		Total	**34**	**13.60**
	No		216	86.40
	Total		**250**	**100**
Cleaning udder	**Not applicable**		216	86.40
	Yes		16	6.40
	No		18	7.20
	Total		**250**	**100**
Washing utensils before milking	**Not applicable**		216	86.40
	Yes		34	13.60
	No		0	0
	Total		**250**	**100**

Table-5: Association between knowledge and practice (Milk contamination and washing hands and utensils before milk collection) (n=250)

Knowledge and practice		Milk Contamination			
		Yes		No	
		No	%	No	%
Washing hands before collection	**Yes**	32	12.8	2	0.8
	No	198	79.2	18	7.2
	Total	**230**	**92.0**	**20**	**8.0**
		χ^2=0.845; p=0.358			
Washing utensil before collection	**Yes**	34	13.6	0	0
	No	206	82.4	10	4.0
	Total	**240**	**96.0**	**10**	**4.0**
		χ^2=3.473; p=0.062			
Addition of water to milk after collection	**Yes**	2	0.8	32	12.8
	No	78	31.2	138	55.2
	Total	**80**	**32.0**	**170**	**68.0**
		χ^2=63.658; p=0.000			
Cover milk utensil with lid after collection	**Yes**	34	13.6	0	0
	No	216	86.4	0	0
	Total	**250**	**100**	**0**	**0**
		χ^2=4.87; p=0.027			

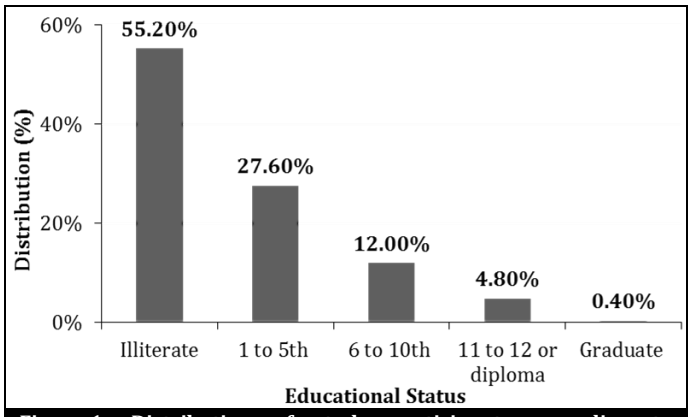

Figure-1: Distribution of study participants according to educational status

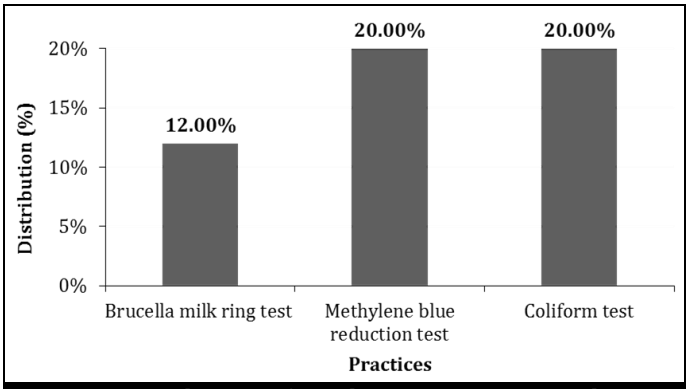

Figure-2: Distribution of study participants according to laboratory analysis of animal milk samples collected

None of the participants had refrigeration facility to store milk. Majority of study participants (86.40%) had no milk producing animal sources. 8.4% of the households preferred to keep animals in separate shed (Table 3). Participants hardly used to wash animals daily (3 out of 34), 50% of the participants possessing animals washed udder before milking, and all of them washed utensils before milking (Table 4).

Among 25 samples collected for laboratory analysis, 3 (12%) samples were found positive for Brucella milk ring test and 5 (20%) samples were positive for Methylene Blue Reduction test as well as Coliform test. Milk samples positive for Coliform test indicate > 10^5 bacteria per ml of milk. Specific gravity was 1.026 ± 0.004. (Figure 2)

The knowledge regarding milk contamination with that of practice of addition of water to milk and covering milk utensils with lid was better in participants. This result was found statistically significant. (Table 5)

Discussion

The importance of milk in human diet is well established, as it is considered as the best, ideal and complete food for all age groups. However, in spite of being so, milk can also serve as a potential vehicle for transmission of some diseases under certain circumstances.

A study done in Ghana in 2003, reported that 46% respondents were males and 54% were females and in Tanzania 73% respondents were males compared to 27% females.[20] Present study showed majority participants handling milk were females, it may be because of working men.

A study conducted at New Delhi in 2000 reported that, as for health insurance, most Indians are not covered by

any insurance schemes, but among small minority that was covered, most belonged to organized urban sector – the rural population had almost no insurance coverage at all.[21] Present study showed similar findings.

A study done in Tanzania in 2006 showed, 86% of milk sources were from small scale producers and 14% from milk collection centers.[18] Similar study done in Kenya in 2000 reported milk sources as follows - 20% form dairy, 28% from vendors and 12% from shops.[22] Another study done in USA in 2006 reported, 71.4% of milk sources were from own farm and 31.4% from grocery stores.[19] Where as in present study, nearly half of the participants preferred milk from vendors and nearly another one third from dairy.

Various studies showed that 23% to 68.5% of the study participants were aware of diseases transmitted from milk[19-23], where as in present study, awareness regarding milk borne diseases was nil. Lack of this knowledge may be one of the reasons for consuming raw milk.

A study done in USA in 2006, 42.3% of surveyed dairy producers reported the taste and convenience as primary reason to consume raw milk.[25] Present study showed that 1/3rd participants consume raw milk, and very less reported convenience and taste as primary reason. Consumption of raw milk is a preventable cause of food-borne illness, making pasteurization of raw milk an important public health tool for food-borne disease prevention. One way to approach this problem would be to develop educational outreach programs for dairy producers, as well as for the general public, that focus on issues related to the consumption of raw milk.

Various studies reported that 20% to 83% of milk samples were adulterated with water.[5,18,20,25,26] Similar findings were reported in the present study. Various studies reported that 23% to 61% respondent's stored milk in refrigerator[18,20,26], whereas in our study, none of participants possessed refrigerator facility for storage of milk.

From the laboratory analysis of 25 milk samples, 5 (20%) samples were positive for Methylene Blue Reduction test as well as Coliform test. Milk samples positive for coli form test indicate 10^5 bacteria per ml of milk. This may be due to poor practices of participants regarding washing animals and udder before milking. The results indicate that bulking of milk from many areas and production systems could pose significant health risks if the milk is not pasteurized or adequately boiled. The high bacterial counts mainly reflect poor hygiene and a long time-lag between milking and sale of the milk. The participant's knowledge was better in some practices like not adding water to milk before consumption, keeping milk utensil in safe place with lid covered.

Future efforts should focus on improving milk quality by informal market agents by training and extension on appropriate handling containers, milk temperature regulation and other factors. Of greatest risk in this regard is raw milk purchased from multiple-source markets, often at great distances. Actual health risks from bacterial contamination are already judged to be low because of the common consumer practice of boiling milk before consumption, a practice that should be further encouraged. This practice may decrease the need for strict implementation of regulations preventing raw milk marketing.

Conclusion

Awareness about milk borne diseases was nil among participants. Attitude towards milk consumption practices was not satisfactory. One way to approach this problem would be to develop educational outreach programs for dairy producers, as well as for the general public, that focus on issues related to the consumption of raw milk.

ACKNOWLEDGEMENT

We would like to thank to Dr. VD Patil (MD, DCH), Principal, Jawaharlal Nehru Medical College, Belgaum for having given me an opportunity to undertake the present study. Our sincere gratitude to Dr. (Mrs.) Vijaya A Naik (MD, DPH), Professor and Head, and all faculty and office members, Department of Community Medicine, Jawaharlal Nehru Medical College, Belgaum for constant encouragement and support.

References

1. Chatterjee SN, Bhattacharjee I, Chatterjee SK, Chandra G. Microbiological examination of milk in Tarakeswar, India with special reference to coliforms. African J Biotechnol 2006;5:1383-5.
2. Kivaria FM, Noordhuizen JP, Kapaga AM. Evaluation of the hygienic quality and associated public health hazards of raw milk marketed by smallholder dairy producers in the Dares Salaam region, Tanzania. Trop Anim Health Prod 2006;38:185-94.
3. Rosenthal I. Milk and dairy products properties and processing. New York: Balaban Publishers VCH; 1991.
4. Hemme T, Garcia O, Saha A. A review of milk production in India

with particular emphasis on small scale producers. Rome, Italy: Food and Agricultural Organization, Animal Production and Health Division, Vialle Delle Terme Di Caracalla; 2003.
5. Swai ES, Schoonman L. Microbial quality and associated health risks of raw milk marketed in the Tanga region of Tanzania. Asian Pacific J Trop Biomed 2011;1:217-22.
6. Gedam K, Prasad R, Vijay VK, Chanda GC. The Study on UHT Processing of Milk: A Versatile Option for Rural Sector. World J Dairy & Food Sci 2007;2:49-53.
7. Muhammad K, Altaf I, Hanif A, Anjum AA, Tipu MY. Monitoring of hygienic status of raw milk marketed in Lahore city, Pakistan J Animal Plant Sci 2009;19:74-7.
8. Chanda GC, Noor Uddin GM, Deb A, Bilkis T, Chowdhary S, Basir M. Microbiological profile of the traditionally collected industrial raw milk from the milk pocket zones of Bangladesh. Bangladesh J Microbiol 2008;25:17-20.
9. Wallace RL. Bacteria Counts In Raw Milk. 2009. Available from: URL: http://en.engormix.com/MA-dairy-cattle/management/articles/bacteria-counts-raw-milk-t1285/124-p0.htm
10. Park K. Park's Textbook of Preventive and Social Medicine. 20th Ed. Jabalpur, India: Banarasidas Bhanot; 2009.
11. Donkor ES, Aning KG, Quaye J. Bacterial contaminations of informally marketed raw milk in Ghana. Ghana Med J 2007;41:58-61.
12. Sharp JCM. Infections associated with milk and dairy products in Europe and North America, 1980-85. Bull World Health Organ 1987;65:397-406.
13. Milk quality and safety. Available from: URL: http://www.capetown.gov.za/en/cityhealth/envirohealth/foodqulityandsafety/pages/milkqualitysafety.aspx
14. Oliver SP, Jayarao BM, Almeida RA. Foodborne pathogens in milk and the dairy farm environment: food safety and public health implications. Foodborne Pathog Dis 2005;2:115-29.
15. Omore AO, Muriuku H, Kenyanjui M, Owango M, Staal S. Research Report of the MoA/KARI/ILRI Small holder Dairy (R&D) Project. Nairobi Kenya: International Livestock Research Institute; 1999.
16. Abraham CA, Laryea AM. Preliminary investigation of the bacteriology of raw milk produced on the Accra plains. Ghana Med J 1968;7:100-3.
17. Ayebo D, Assoku RKG, Oppong ENW. A study of the bacteriology of raw milk produced on the Accra Plains of Ghana. Ghana J Sci 1976;16:9-18.
18. Kivaria FM, Noordhuizen JP, Kapaga AM. Evaluation of the hygienic quality and associated public health hazards of raw milk marketed by smallholder dairy producers in the Dar es Salaam region. Tanzania Trop Anim Hlth Prod 2006;38:185-94.
19. Jayarao BM, Donaldson SC, Straley BA, Sawant AA, Hegde NV, Brown JL. A Survey of Food borne Pathogens in Bulk Tank Milk and Raw Milk Consumption Among Farm Families in Pennsylvania, USA. Dairy Sci 2006;89:2451-8.
20. Omore A, Staal SJ, Osafo ELK, Kurwijilla L, Barton D, Mdoe N, et al. Market mechanisms, efficiency, processing and public health risks in peri-urban dairy product markets: synthesis of findings from Ghana and Tanzania. Final Technical Report for LPP Project R7321. Nairobi, Kenya: International Livestock Research Institute; 2004.
21. Kulkarni GA. Health Insurance for Workers in Informal Sector, Detailed Results from a pilot study. New Delhi: National Council for Applied Manpower Research; 2000.
22. Mwangi A, Arimi SM, Mbugua S, Kangethe EK, Ouma EA, Omore AO, et al. Assurance of marketed milk quality in Kenya. Kenya: University of Nairobi; Faculty of Veterinary Medicine Biennial Scientific Conference, 30-31 Aug, 2000.
23. Omore A, Arimi S, Kangethe E, McDermott J, Staal S, Ouma E, et al. Assessing and Managing Milk-borne Health Risks for the Benefit of Consumers in Kenya. Nairobi, Kenya Smallholder Dairy (R&D) Project; 2002.
24. Omore AO, McDermott JJ, Staal S, Arimi SM, Kang'ethe EK, Ouma EA. Analysis of public health risks from consumption of informally marketed milk in sub-Saharan African countries. Paper presented at the 9th International Symposium on Veterinary Epidemiology and Economics (ISVEE), 6-11 August 2000, Beckenridge, Colorado, USA. Nairobi (Kenya): International Livestock Research Institute; 2000.
25. Mwangi A, Arimi SM, Mbugua S, Kangethe EK, Ouma EA, Omore AO, et al. Application of HACCP to improve the safety of informally marketed raw milk in Kenya International Symposia on Veterinary Epidemiology and Economics (ISVEE) proceedings, ISVEE 9: Proceedings of the 9th Symposium of the International Society for Veterinary Epidemiology and Economics, Breckenridge, Colorado, USA, Food safety: dairy production session, Aug 2000. p. 504.
26. Grace D, Baker D, Randolph T. Innovative and Participatory Risk-Based Approaches to Assess Milk-Safety in Developing Countries: a case study in North East India Nairobi, Kenya: International Livestock Research Institute (ILRI): Paper presented at the International Association of Agricultural Economists (IAAE) conference in Beijing, China, 17-22; 2009.

Cite this article as: Neeta PN, Prashanth N, Shivaswamy MS, Mallapur MD. A study on awareness regarding milk borne diseases in an urban community of Karnataka. Int J Med Sci Public Health 2014;3:1093-1099.
Source of Support: Nil
Conflict of interest: None declared