academicJournals

Vol. 8(5), pp. 86-94, April 2014
DOI: 10.5897/JCAB2013.0411
Article Number: F2ED99B44446
ISSN 1996-0867

http://www.academicjournals.org/JCAB

Journal of Cell and Animal Biology

Full Length Research Paper

Application of hazard analysis critical control point (HACCP) system in dairy farms in Khartoum State, Sudan

Ranya Siddeeg Omer[1] and Atif Elamin Abdelgadir[2]*

[1]Private Sector, Khartoum North, Sudan.
[2]Department of Preventive Medicine and Public Health, Faculty of Veterinary Medicine, University of Khartoum, P.O. Box 32, Khartoum, Sudan.

Received 16 March, 2014; Accepted 25 April, 2014

An attempt was made to apply hazard analysis critical control points (HACCP) system in dairy farms in Khartoum State and to suggest control limits for them based on the international standard. World Health Organization (WHO) and Food and Agriculture Organization (FAO) recommended the HACCP system as a modern tool for prevention. Critical points associated with animal health were investigated using screening tests such as California mastitis test (CMT) and rose bengal plate test (RBPT) for detection of bovine mastitis and brucellosis, respectively. The results reveal that the overall prevalence rate of bovine mastitis at the animal level was very high, 69.3% (n=104, out of 150). While, the overall prevalence rate of 36% (n=54, out of 150) was recorded for brucellosis in dairy farms in Khartoum State. Other critical points were obtained from the owners of the dairy farms by means of a questionnaire using non-probability sampling method or willingness of the owners for interview. The main results showed that tick infestation was present in most of the dairy farms, 94% (n=141, out of 150) and application of the odds ratio indicated that tick infestation could be a risk factor (OR=1.694). Using antibiotics for treatment of infected animals was also confirmed in this study as 54.7% (n=82, out of 150). On the other hand, the critical points associated with environment in dairy farms and distribution of the milk in Khartoum State was investigated using questionnaire survey and non probability sampling method was employed. The main results show that the condition of beddings was poor in 105 dairy farms (out of 150), given a percentage of 70%. Absence of the cleaning and disinfection of the teat were recorded in 108 and 104 dairy farms (out of 150), respectively. Many critical points associated with animals or environment as observed in dairy farms in Khartoum State included infectious and zoonotic disease, presence of flies and tick infestation, using antibiotics for treatment or in feed and drinking water and absent of veterinary care in the most dairy farms. While, critical points associated with environment were poor hygienic conditions during different practices, handling, storage and distribution of the milk. Moreover, the control limits for the all mentioned critical points were as follow: access to veterinary service using disinfections and detergents, vectors control, improvement of general hygienic conditions in the environments in the dairy farms during different practice as well as consideration of the issue of temperature during storage and distribution of the milk.

Key words: Critical control points, dairy farms, Khartoum State, Sudan.

INTRODUCTION

The objective of food safety is to reduce food illnesses and fatalities. The health and hygiene of the cow, the environment in which the cow are housed and milked and hygiene during milking and storage equipments, all influence microbial numbers of milk. Furthermore, milk is considered as good medium for bacteria including pathogenic organisms which have a great impact on public health (Ibtisam and Mohboba, 2007).

Hazard analysis critical control points (HACCP) concept was introduced in the United States in 1971 at the Conference of Food Protection where it was recommended for widespread use (Bauman, 1974). The call for change was galvanized in the early 1990s with a tragic outbreak of *Escherichia coli* O157:H7 food borne illness in the North West of the United States.

Zoonotic diseases such as brucellosis and tuberculosis can be transmitted by using unhygienic milk or milk products. These diseases have been reported from different parts of Sudan. For instance, Khalid (2006) reported that the prevalence rate of brucellosis in Khartoum State was 23.2% using rose bengal plate test (RBPT). A research work by Naglaa (2007) confirmed the presence of tuberculosis in both cattle and man in Khartoum state using single intradermal comparative tuberculin test (SICTT), bacteriological procedures and nested polymerase chain reaction (NPCR).

Mastitis in dairy cows is a multifactorial disease with a long history among the economic loss due to the loss of milk production, treatment costs, extra labor and premature culling of chronically infected cows. Hygiene at all levels: housing, feeding cows in the barn, milking, should be addressed. When an Udder Health Control (UHC) programme is designed and implemented, it warrants a persistent and protocol-based approach by both the farmer (and his co-workers) and a coaching veterinarian in all areas of udder health (Hancock and Dargatz, 1995).

Raw milk is approximately 67-70°C as it comes from the cow, and needs to be chilled to 8°C as fast as possible. To transport fresh raw milk, a cooler or ice chest is needed in order to keep the milk at a cool 40°F or lower at all times Pre-milking sanitation (udder washing) is a critical point for controlling the bacteria count in milk (Mossel et al., 1995). Hazard-aware dairy workers that work with dairy animals or work in and around dairy operations, should wear personal protective equipment (PPE) for certain jobs and know safety precautions to follow when handling chemicals or when in areas of hazardous atmospheres. Hazard analysis critical control points addresses product quality through the control of the production process. It was originally developed for the NASA space programme to safeguard astronauts from chemical, physical and micro-biological hazards through food (Hulebak and Schlusser, 2002).

Objectives of the study

1. To apply hazard analysis critical control points (HACCP) system in dairy farms in Khartoum State in order to clarify if this approach may yield better result than conventional methods.
2. To determine the critical points associated with animals, environment in farms and distribution of the milk which can affect the quality of the milk for human consumption.
3. To suggest the control limits for the different critical points based on the recommended international standards.

MATERIALS AND METHODS

Study area

Khartoum State is located in central Sudan, altitude: 382 m (1253 ft). The average temperature in Khartoum, Sudan is 29.8°C (86°F). The average monthly temperature is 10.5°C. The warmest average maximum/high temperature is 42°C (108°F) in May and June. The coolest average minimum/low temperature is 16°C (61°F) in January. Khartoum receives on average 164 mm (6.5 in) of precipitation annually or 14 mm (0.5 in) each month. On balance, there are 18 days annually on which greater than 0.1 mm (0.004 in) of precipitation (rain, sleet, snow or hail) occurs or 2 days on an average month. The month with the driest weather is January, February, March, November and December when on balance 0 mm (0.0 in) of rainfall (precipitation) occurs. The month with the wettest weather is August when on balance 72 mm (2.8 in) of rain, sleet, hail or snow falls across seven days. Mean relative humidity for an average year is recorded as 21.8% and on a monthly basis it ranges from 13% in March, April to 42% in August. Hours of sunshine range between 8.4 h per day in July and 11.1 h per day in February. On balance, there are 3664 sunshine hours annually and approximately 10.0 sunlight hours for each day. On balance there are 0 days annually with measurable frost and in January there are on average 0 days with frost.

Determination of the critical points

Critical points associated with animals

Milk samples and serum samples were collected from dairy farms from different sites of Khartoum State (Khartoum, Omdurman and Khartoum North) in order to determine the presence of bovine mastitis and brucellosis.

*Corresponding author. E-mail: atifvet@yahoo.com.

Table 1. Interpretation of CMT results and relationship with SCC.

Total cell count	Visible reaction	Interpretation	CMT score
0-200,000 0-25% Neutrophil	Milk fluid and normal	Negative	0
150,000-500,000 30%-40% Neutrophil	Slight precipitation	Trace	+ -
400,000-1,500,000 40%-60% Neutrophil	Distinct precipitation but no gel formation	Weak positive	1
300,000-5,000,000 60%-70% Neutrophil	Mixture thickness with a gel formation	Distinct positive	2
>5,000,000 70-80% Neutrophil	Viscosity greatly increased strong gel that is cohesive with a convex surface	Strong positive	3

Source: Quinn et al. (1994).

Sampling methods

A total of 150 milk and serum samples were collected from dairy farms (10 farms in Khartoum, 15 farms in Omdurman and 12 farms in Khartoum North). Selection of the dairy farms was based on the willingness of the owners. It means not all the dairy farms have the same opportunity to be selected and this called is non-probability sampling method as described by Thrusfield (2007).

Collection of the milk samples

A total of 150 milk samples (50 in Khartoum, 50 in Omdurman and 50 in Khartoum North) were collected at the animal level for determination of the presence of bovine mastitis. Before the collection of milk samples, the teats were disinfected with cotton wool moistened with 70% ethyl alcohol. California mastitis test was employed immediately after collection of the milk samples in the dairy farms.

California mastitis test (CMT)

CMT was carried out using the method described by Schalm et al. (1971) and Quinn et al. (1994). Briefly, equal volumes of commercial CMT reagent and milk sample were mixed and formation of the gel was observed. The interpretation of the result was done as described by Quinn et al. (1994) (Table 1). For the analysis, negative (0) and trace (±) were considered as negative results and different intensities of positive (1, 2 and 3) were considered as positive results.

Collection of blood samples

A total of 150 serum samples (50 in Khartoum, 50 in Omdurman and 50 in Khartoum North) were collected for determination of the presence of bovine brucellosis. The blood samples were collected from venipuncture of the jugular vein using syringes. Later sera was separated from the clots, placed in the plastic vials, preserved in ice box and transported as soon as possible to the laboratory, Faculty of Veterinary Medicine, University of Khartoum.

Rose Bengal plate test (RBPT)

The serum samples and the antigen were removed from the refrigerator and placed at room temperature for an hour, and then the test was done by dispensing 0.025 ml of each serum to be tested in an enamel plate. The same amount of RBPT antigen was added to each serum and both were mixed together, shaked by hand for four minutes and the test was immediately read. Agglutination appeared as weak positive, positive, strong positive or very strong positive.

Other critical points that associated with animals

Other critical points associated with animals were obtained from the owners of the dairy farms by the means of questionnaire. A total of 150 owners responded to the questionnaire (50 in Khartoum, 50 in Omdurman and 50 in Khartoum North). Selection of the owners was based on their willingness for interview (Non-probability sampling method) as described by Thrusfield (2007). Information on tick infestation, presence of clinical cases, history of abortion, access to veterinary service, presence of zoonotic diseases and additions of antibiotics to the diet or drinking water were recorded (Appendix 1).

The critical points associated with environment and distribution of the milk

Information on general conditions of environment in the dairy farms and transportation of the milk were obtained from the owners by the means of questionnaire using non-probability sampling methods as described by Thrusfield (2007). Information such as type of housing, condition of housing, condition of bedding, using detergent, cleaning or disinfection of the teat, milkers, store and distribution of the milk were recorded.

Data analysis

IBM SPSS version 19 was used for data analysis. The results were presented as descriptive statistic in tables using frequency and percentage. While, analytical statistic using Chi-square (2) and odds ratio (OR) was employed for purpose of getting significance level and estimation of the risk associated with critical points in dairy farms in Khartoum state. For Chi-square (2), the interpretation depended on p-value. For instance, if p-value is less than 0.05, the difference was considered significant. OR was used only for significant association and when the OR is greater than one, the factor could be a risk factor. In contrast, when the OR is less than one, the factor could be protective factor.

Table 2. The presence of bovine mastitis and brucellosis in dairy farms in Khartoum State.

Study site	Bovine mastitis	Brucellosis
	No. of prevalence of examined the cases (%)	No. of prevalence of examined the cases (%)
1. Khartoum	50 41 27.3	50 15 10
2. Omdurman	50 40 26.7	50 20 13.3
3. Khartoum North	50 23 15.3	50 19 12.7
Over all	150 104 69.3	150 54 36

Bovine mastitis based on CMT and scores of 1, 2 and 3 were considered positive; Brucellosis based on RBPT.

RESULTS

This study was carried out in dairy farms in Khartoum State to determine the critical points that can influence the quality of the milk as well as to suggest the control limits for them. The presence of bovine mastitis and brucellosis in dairy farms in Khartoum State was investigated and the results revealed that the overall prevalence rate of bovine mastitis based on CMT at animal level was very high, 69.3% (n = 104, out of 150) 27.3% (n=41), 26.7% (n=40) and 15.3% (n=23), for Khartoum, Omdurman and Khartoum North, respectively. While, the overall prevalence rate of brucellosis based on RBPT was 36% (n=54, out of 150), 10% (n=15), 13.3% (n=20) and 12.7% (n=19) for Khartoum, Omdurman and Khartoum North, respectively (Table 2).

Other critical control points associated with animals were investigated using questionnaire survey. The main results showed that tick infestation was present in most of the dairy farms in Khartoum state, 94% (n=141 out of 150). Moreover, the presence of the zoonotic diseases as well as using antibiotics for treatment of the infected animals were confirmed in this study as 54.7% (n=82 out of 150) and 75.3% (n=113 out of 150), respectively. It was observed that the access to the veterinary services was absent in most of the dairy farms, given a percentage of 70% (n = 105, out of 150). The rest of the results are presented in Table 3.

Estimation of some risk factors associated with animals based on access to veterinary services revealed that the tick infestation could be a risk factors (OR = 1.694). While using of antibiotics for the treatment of the animals could be a protective factor (OR = 0.453) (Table 4).

The control limits of presence of brucellosis and other zoonotic diseases can be achieved by the culling or treatment of the infected animals. Withdrawal period should be considered in case of addition of antibiotics to feed and drinking water or using antibacterial for the treatment of infected animals.

On the other hand, the critical points associated with environment in dairy farms in Khartoum State were investigated using questionnaire survey. The main results showed that the condition of beddings was poor in 105 dairy farms (out of 150) given a percentage of 70%. Absence of the cleaning and disinfection of the teat were recorded in 108 and 104 dairy farms (out of 150) given a percentage of 72 and 69.3%, respectively. Moreover, hand washing of the milkers was obtained only for 32% of the dairy farms (n = 48, out of 150). Store of the raw milk at the room temperature was almost found in farms (100%).

Distribution of the milk was dependent on either vehicle without chilling (50%) or donkey cart (49.3%) (n = 76 and 74 out of 150, respectively) (Table 5) (Figures 1 and 2). Estimation of some risk factors associated with environment in the dairy farms in Khartoum State on the basis of regular examination of the milk revealed that hand washing of the milkers could be a risk factor (OR = 2.574). While, the condition of the housing (Figure 2) as well as the distribution of the milk could be a protective factor (OR = 0.383 and 0.278, respectively). The results are presented in Table 6.

Good ventilation, avoiding overcrowding and regular removable of waste are known as the best methods for controlling the bad conditions of housing and bedding. While, temperature and good hygienic practice are necessary for protection of raw milk from growth of microorganisms during different practice in the dairy farms: handling, store and distribution of the milk.

DISCUSSION

This study was conducted in dairy farms in Khartoum State in order to apply HACCP. Both the critical control points associated with animals or environment were determined by using either the screening tests or questionnaire survey.

As seen from the results, the morbidity rate of bovine mastitis and brucellosis was very high in dairy farms in Khartoum State. These diseases are known as one of critical points associated with animals. A number of researchers in Sudan confirmed the presence of infectious disease particularly zoonotic diseases in intensive and semi-intensive production system. For instance, Khalid (2006) reported that the prevalence rate of brucellosis in Khartoum State was 23.2% using Rose Bengal test (RBT).

Similarly, a study by Mahmoud (2010) showed that the prevalence rate of the disease was 24.6, 13.6 and 5% by RBPT, serum agglutination test (SAT), ELIZA and milk ring test (MRT), respectively in West Kordofan State.

Table 3. Summary of questionnaire survey responses with regard to critical points associated with animals.

Unit	Site (Khartoum Omdurman Khartoum North)	Total	Chi-square *p*-value	Interpretation
Tick infestation				
Yes	50(/100%) 50(/100%) 41(82%)	141(94%)	$\chi^2_{=19.1}$	Significant
No	0(0%) 0(0%) 9(18%)	9(6%)	*P*=0.00 (p<0.05)	
Presence of flies				
Yes	35(70%) 38(76%) 28(56%)	101(67.3%)	$\chi^2_{= 4.8}$	Not significant
No	15(30%) 12(24%) 22(44%)	49(32.7%)	*P*=0.09 (p>0.05)	
Access to veterinary service				
Yes	11(22%) 16(32%) 18(36%)	45(30%)	$\chi^2_{= 2.5}$	Not significant
No	39(78%) 34(68%) 32(64%)	105(70%)	*P*= 0.3(p>0.05)	
Presence of abortion				
Yes	25(52%) 16(/32%) 31(62%)	73(48.7%)	$\chi^2_{= 9.3}$	
No	24(48%) 34(68%) 19(38%)	77(51.3%)	*P*=0.009 (p<0.05)	Significant
Presence of zoonotic diseases				
Yes	18(36%) 21(41%) 43(86%)	82(54.7%)	$\chi^2_{=30.1}$	Significant
No	32(64%) 29(58%) 7(14%)	68(45.3%)	*P* =0.005 (p<0.05)	
Using antibiotic for treatment				
Yes	39(78%) 37(74%) 37(74%)	113(75.3%)	$\chi^2_{=0.3}$	Not. Significant
No	11(22%) 13(26%) 13(26%)	37(25.7%)	*P*= 0.9 (p>0.05)	
Addition of antibiotic to feed				
Yes	18(36%) 11(22%) 4(8%)	33(22%)	$\chi^2_{=11.4}$	
No	32(64%) 39(78%) 46(92%)	117(78%)	*P*= 0.003 (P<0.05)	Significant
Addition of antibiotic to drinking water				
Yes	12(24%) 14(28%) 13(28%)	39(26%)	$\chi^2_{=0.2}$	Not.
No	38(76%) 36(72%) 37(74%)	111(74%)	*P* = 0.9(P>0.05)	significant

Both clinical and sub-clinical mastitis were also observed in dairy farms in Khartoum State (Nuha, 2000; Rofaida, 2010).

Moreover, some pathogens such as *Staphylococcus areus, Streptococcus pyogene* and *Escherichia coli* are considered to be one of the major pathogens that cause bovine mastitis as well as major public health concern. Many authors have isolated the above mentioned pathogens from different part of the country (Abubaker, 2005; Elias, 2007; Nahid and Ibtisam, 2007). A research work by Naglaa (2007) confirmed the presence of tuberculosis in both cattle and man in Khartoum State using single intradermal comparative tuberculin test (SICTT), bacteriological procedures and nested polymerase chain reaction (NPCR).

Other information associated with animal health in the dairy farms were obtained from the owners using questionnaire survey and the results confirmed the presence of flies, tick infestation, abortion and zoonotic diseases and there was no access to veterinary services in the most of the dairy farms in the study area. All above mentioned factors have a great impact on animal health which can affect both the quantity and quality of the milk for human consumption.

Regarding the detection of antibiotics in milk, most of the owner in this study used antibiotics for treatment of the animals and some of them added them to feed or drinking water. Similary, Abdel Rahman (2001) stated

Table 4. Estimation of some risks associated with animals based on access to veterinary services.

Factor	Chi - square *P* - value	Odds ratio (OR) 95% CI	Interpretation
Tike infestation	$\chi^2 = 4.103$ *P* = 0.043*	OR = 1.094 95% CI (1.03 - 1.16)	Risk factor
Presence of flies	$\chi^2 = 1.976$ *P* = 0.797	-	Risk cannot be estimated
Presence of abortion	$\chi^2 = 1.221$ *P* = 0.269	-	Risk cannot be estimated
Presence of zoonosis	$\chi^2 = 0.866$ *p* = 0.352	-	Risk cannot be estimated
Using antibiotic for treatment	$\chi^2 = 4.102$ *P* = 0.643*	OR = 0.453 95%CI(0.21- 0.98)	Protective factor
Addition of antibiotic to feed	$\chi^2 = 1.778$ *P* = 0.182	-	Risk cannot be estimated
Addition of antibiotic to water	$\chi^2 = 0.873$ *P* = 0.350	-	Risk cannot be estimated

P-value was significant (p < 0.05); 95% CI = 95% confidence interval.

Figure 1. Distribution of the milk using donkey cart.

Table 5. Summary of questionnaire survey responses with regard to critical points associated with environment in dairy farms and distribution of the milk.

Unit	Site Khartoum Omdurman Khartoum North	Total	Chi-square p-value	Interpretation
Conditions of beddings				
I- Excellent	- - -	-	χ^2=5.14	Not significant
II- Good	12(/24%) 12(/24%) 21(42%)	45(30%)	*P* = 0.076 (*p* > 0.05)	
III- Bad	38(76%) 38(76%) 2 9(58%)	105(70%)		
Conditions Of housing				
I- Excellent	- - -	-	χ^2=14.6	Significant
II- Good	26(52%) 26(52%) 42(84%)	94(62.7%)	*P*=0.001(p< 0.05)	
III- Bad	24(48%) 24(48%) 8(16%)	56(37.3%)		
Using of detergents				
I- Yes	9(18%) 9(18%) 13(26%)	31(20.7%)	χ^2=1.30	Not significant
II- No	41(82%) 41(82%) 32(64%)	119(79.3%)	*P*=0.522 (p > 0.05)	
Cleaning of the teats				
I. Yes	14(28%) 14(28%) 14(28%)	42(28%)	χ^2=0.00	Not significant
II- No	36(72%) 36(72%) 36(72%)	108(72%)	*P*=1.000 (p > 0.05)	
Disinfection of the teats				
I- Yes	18(36%) 18(36%) 10(20%)	46(30.7%)	χ^2= 4.01	Not significant
II- No	32(64%) 32(64%) 40(80%)	104(69.2%)	*P*=0.134(p > 0.05)	
Regular examination of the milk				
I- Yes	25(50%) 37(74%) 18(36%)	80(53.3%)	χ^2=14.84	Significant
II- No	25(50%) 13(26%) 32(64%)	70(46.7%)	*P*=0.001(p< 0.05)	
Hand washing of the milkers				
I- Yes	10(20%) 20(40%) 18(36%)	48(32%)	χ^2=5.147	Not significant
II- No	40(80%) 30(60%) 32(64%)	102(68%)	*P*=0.076(p > 0.05)	
Store of raw milk In the farms				
I- Room temperature	50(100%) 50(100%) 50(100%)	150(100%)	χ^2=7.061	Significant
II- Refrigerator	0(0%) 0(0%) 0(0%)	0(0%)	*P*=0.029(p< 0.05)	
Distribution of the milk				
I- Chilling vehicle	- - -	-	χ^2= 5.5	Not significant
II- Opened vehicle without chilling	32(64%) 21(42%) 23(46%)	76(50.7%)	*P* = 0.064(*p*> 0.05)	
III- Donkey cart	18(36%) 29(58%) 27(54%)	74(49.3%)		

that minimum detectable concentration for oxyteracycline was 2 mg/ml milk, 48 mg/ml milk for benzyl penicillin and 25 mg/ml milk for Tylosin. He also explained that all the milk samples collected from bulk milk of the farms and supermarket were free of antibacterial residues, whereas 76.6% of the samples collected from treated cows with intramammary infusion were positive for antibiotic residues.

Furthermore, Manal (2005) found that 25% of milk samples which were collected from the central market in Khartoum State in summer were positive for antibiotic residues using the strain *Bacillus subtilis* British type ATCC - bb33 as the test organism and her results revealed high positive samples (37.9%) of antibiotic residues in the winter.

As seen from the results, many critical points associated with the general conditions of the environment in dairy farms were observed. For instance, bad conditions of housing and beddings were recorded for most of the dairy farms. Using detergents, cleaning or disinfection of the teats and hand washing of the milkers were used in small scale in our study area. Moreover,

Figure 2. Distribution of the milk using vehicle without chilling.

Table 6. Estimation of some risks associated with environment in the dairy farms and distribution of the milk.

Factor	Chi - square P - value	Odds ratio (OR) 95% CI	Interpretation
Conditions of beddings	$\chi^2 = 7.574$ $P = 0.006^*$	OR = 0.385 95% CI (0.191 - 0.765)	Protective factor
Condition Of housing	$\chi^2 = 0.510$ $P = 0.475$	-	Risk cannot be estimated
Using of detergents	$\chi^2 = 1.648$ $P = 0.306$	-	Risk cannot be estimated
Cleaning of the teats	$\chi^2 = 0.021$ $P = 0.884$	-	Risk cannot be estimated
Disinfection of the teats	$\chi^2 = 0.027$ $P = 0.868$	-	Risk cannot be estimated
Hand washing by the milkers	$\chi^2 = 6.741$ $P = 0.009^{**}$	OR = 2.574 95%CI(1.248 - 5.310)	Risk factor
Store of raw the milk	$\chi^2 = 0.602$ $P = 0.43$	-	Risk cannot be estimated
Distribution of the milk	$\chi^2 = 14.254$ $P = 0.000^{**}$	OR = 0.278 95%CI(0.142 - 0.547)	Protective factor

95% CI: 95% confidence interval; Risks was estimated based on regular examination of the milk.

most of the owners did not consider the importance of low temperature with regard to store and distribution of the raw milk. Our findings are in agreement with that of Nahid and Ibtisam (2007) who state that the hygienic quality of the milk that were collected from the super marks in Khartoum State was very low due to the high bacteria counts, isolation of some microorganisms and detection of *Brucella* by using milk ring test MRT. Cleaning and removal of soil, bedding material and manure from the udder and flanks of the cow before milking is necessary to prevent the entry of many types of bacteria into milk. Milk production in Sudan is faced with several problems such as poor husbandry practices, bad handling of raw milk during its storage at the farm and

during transportation, bad information infrastructure, poor cooling facilities, high ambient temperature and the long distance between sites of production and consumption centers.

An attempt was also made in Sudan to apply HACCP. For example, a study by Nuha (2009) in dairy farms in Khartoum State revealed poor building construction, poor water supply, poor farms as well as milkers hygiene and accumulation of dung and animal waste. The same author stated that two critical points were assigned to milk distribution chain, the first critical point was to control raw milk production hygiene distribution chain, while the second critical control point was to control milk temperature.

Conclusion

Many critical points associated with animals or environments were observed in dairy farms in Khartoum State: 1, Critical points associated with animals or environments include (infectious and zoonotic disease, presence of flies and tick infestation, using antibiotics for treatment or in feed and drinking water and absent of veterinary care in the most dairy farms). 2, while, critical points associated with environment were poor hygienic conditions during different practices: handling, storage and distribution of the milk.

Moreover, the control limits for the all mentioned critical points were as follow: access to veterinary service using disinfections and detergents, vectors control, improvement of general hygienic conditions in the environments in the dairy farms during different practice as well as the consideration of the issue of the temperature during storage and distribution of the milk.

Recommendations

1. Dairy farms should implement a documented food safety management system based on HACCP principles.
2. Using bacterial counts or somatic cell count (SCC) as well as regular examination of the milk using screening tests such as CM) and MRT are required for evaluations of the quality of the milk.
3. An attention should be made for increasing awareness of the owners, technical and financial resources, an effective institutional frame work, trained man power and sufficient information on hazard and risks involved.
4. It is important that milk distribution chain should be monitored by health and veterinary authorities to ensure safe milk to consumers.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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