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Factors Associated With Spread of Brucellosis: Empirical Evidence from Community Members in Mandera East Sub-county, Kenya

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Abstract

Brucellosis causes more than 500,000 infections per year worldwide. Its geographic distribution is limited by effective public and animal health programs, and the prevalence of the disease varies widely from country to country. Overall, the frequency of brucellosis is higher in more agrarian societies and in places where handling of animal products and dairy products is less stringent. Currently, about half a million human brucellosis cases are annually reported worldwide but the estimated number of unreported cases due to the unspecific clinical symptoms of the disease is supposed to be 10 times higher. In endemic countries prevalence rates often exceed 10 cases per 100,000. The objective of this study was to establish the factors associated with spread of brucellosis among community members in Mandera East Sub-county, Kenya. The study use descriptive cross sectional survey design. Qualitative and quantitative data was collected from a sample of 420 respondents specifically from a population 2,617 heads of households form Mandera East Sub-county. The study instruments included semi-structured questionnaire, Focus Group Discussion guide and Interview Guide. Data was analyzed using SPSS Version 20 and results of the study presented in frequencies and percentages in Tables and Figures. Ethical clearance was sought from Kenyatta University Ethical Clearance Committee, permit to carry out the study was sought from NACOSTI and consent sought from the respondents. The study the factors associated with the spread of brucellosis among the community members in Mandera East Sub-county included directly getting into contact with animals such as goats, cows, wild animals dogs, camels, and sheep and taking poorly prepared milk; consuming raw blood from livestock; taking raw or poorly cooked meat and getting involved in various activities touching on livestock

Keywords: Spread of Brucellosis, Community Members in Kenya

1.0 Introduction

The global burden of human Brucellosis remains enormous with the infection causing more than 500,000 infections per year worldwide (Godfroid, 2013). However it has been, or is close to being eradicated from a number of developed countries although it is more of a problem in countries with poorly standardized animal and public health programs. It is widely spread in the countries of Europe, North and East Africa, the Middle East, South and Central Asia, Central and South America and is a major cause of morbidity to both humans and animals in these countries (Robert *et al.,* 2010). It is also considered a potential biological weapon (Jovanka *et al*., 2010). The annual number of reported cases has dropped significantly because of aggressive animal vaccination programs and milk pasteurization, familiarity with the manifestations of brucellosis

Vol. 3, No. 06; 2019

ISSN: 2581-3366

and knowledge of the optimal laboratory studies which have been essential for the recognition of this re-emerging zoonosis (Glynn and Lynn, 2008).

As with other public-sector animal health services, the surveillance and control of brucellosis in sub-Saharan Africa is rarely implemented outside southern Africa (McDermott *et al.*, 2012). International trade in animals and animal products poses a major risk of international spread of animal and human pathogens. Zoonotic diseases especially brucellosis remain a serious obstacle to public health. Brucellosis is even more ignored in humans and most cases go undiagnosed and untreated, leading to considerable suffering for those affected (McDermott *et al.*, 2002). Currently, about half a million human brucellosis cases are annually reported worldwide but the estimated number of unreported cases due to the unspecific clinical symptoms of the disease is supposed to be 10 times higher. In endemic countries prevalence rates often exceed 10 cases per 100,000 populations (Godfroid, 2013).

Brucellosis is primarily an infection of animals but can be transmitted to man. Different species of *Brucella* bacteria mostly infect domestic livestock: cattle (B. *abortus*), sheep and goats (B. *melitensis*) and pigs (B. *suis*). Dogs can also be infected with B. *canis*. This can all infect humans with B. *melitensis* thought to cause the most serious disease. *Brucella* possesses a unique ability to invade both phagocytic and nonphagocytic cells and to survive in the intracellular environment by finding ways to avoid the immune system. This ability helps explain why brucellosis is a systemic disease and can involve almost every organ system. The apparent prevalence of brucellosis from milk is high among the dairy farming households (Kangethe, et al. 2007). The prevention of brucellosis infection in humans is a major reason for the advocacy of milk pasteurization worldwide

The informal milk markets thrive because they provide social and economic benefits to smallholder producers. In Kenya, over 85% of marketed milk is not pasteurized and is sold through informal market pathways (Omore et al., 2002). Concerns about human health risks from these market pathways need to be addressed in the context of consumer practices, such as boiling, to reduce or eliminate potential infection by milk-borne health hazards, without discouraging the smallholders milk markets (Kang'ethe, 2000). One of the most effective interventions for primary prevention of brucellosis is health promotion, promotion of a healthy lifestyle from the hygiene aspect, food safety, risk estimation, and application of adequate measures adjusted to the local needs and etiological factors.

In the Kenyan context, Local families in Mandera East Sub-county incur losses on medication of brucellosis besides costs incurred by livestock producers through abortion in infected livestock; social and economic progress and food security losses from young livestock that are born weak and die within 7 days of birth (Robert, 2013). Infected young livestock that live, but are hindered in their growth; loss of milking ability of infected livestock; decreased reproductive efficiency through the livestock either breeding back late or not at all; loss of genetic potential due to involuntary culling of infected animals that would have contributed to the herds genetic makeup (Green & Bradley, 2012). The losses have increased poverty levels, social conflicts,

Vol. 3, No. 06; 2019

ISSN: 2581-3366

malnutrition, morbidity and mortality rates. This study the factors associated with spread of brucellosis among community members in Mandera East Sub-county, Kenya where livestock represents an important factor in the economy and livelihood.

2.0 Literature Review

Brucellosis is a worldwide infection traditionally associated with farmworkers, veterinarians and persons whose occupation includes packing of meat or dairy products. Ingestion of unpasteurized goat milk and related dairy products is the main route by which B *melitensis* is transmitted to humans. Slaughterhouse workers, primarily those in the kill areas are inoculated with *Brucella*e through aerosolization of fluids, contamination of skin abrasions, and splashing of mucous membranes. Farmers and shepherds have similar exposure risks, and they also have exposure to aborted animals. Veterinarians are usually infected by inadvertent inoculation of animal vaccines against B *abortus* and B *melitensis*. Laboratory workers (microbiologists) are exposed by processing specimens (aerosols) without special precautions. Transmission to infants is via breastfeeding.

Nearly every case of human brucellosis has an animal origin *(*Nicoletti, 1992; Tzaneva et al.,2007*)*. Large quantities of the bacteria are excreted with the foetus, placenta and the uterine fluid, mainly at the time of calving. After an abortion or parturition, the organism continues to be excreted mainly via milk of infected cows serving as continued source of infection to humans (Mangen et al., 2002). Human to human transmission and congenital infection have also been documented (Oded et al., 2007; Frank et al., 1993). Exposure through breaks in the skin, following direct contact with tissues, blood, urine, vaginal discharges, aborted foetuses or placentas are also possible routes of transmission of the disease (Gerald et al., 2009).

Transmission occurs as in B. *abortus* mainly through materials excreted by the female genital tract. The primary organ of dissemination is the placenta after abortion or full term parturition. Infection may be direct through contact with contaminated material or aerosol infection, or indirectly by grazing on contaminated pastures or through other materials. Dogs may be vectors mechanically or biologically. Lambs and kids can become infected in utero. B *melitensis* causes disease only in adult animals. Male and female animals are equally susceptible. The husbandry system, as well as environmental conditions, affects the spread of infection. Dogs and some wild carnivores may carry the infection to other places.

A careful history is the most helpful tool in the diagnosis of brucellosis. The history should include both assessment of any risk factors present and evaluation of any symptoms reported (Greenfield, et al., 2002). The risk factors for brucellosis differ somewhat, depending upon whether a given individual resides in or has recently visited a region of endemic disease. Brucellosis should be considered in any patient whose place of residence or dietary, travel, or occupational history suggests a risk for the infection and who is experiencing any of the various complications of brucellosis. The threshold for consideration of brucellosis is low in regions of endemic disease, where diagnostic testing is undertaken for any of the many atypical presentations or unusual complications. Unpasteurized daily products, raw or poorly cooked

Vol. 3, No. 06; 2019

ISSN: 2581-3366

meats are sources of infection in regions of endemic disease. Laboratory transmission of brucellosis may occur, especially in regions of endemic disease (Bouza, et al. 2005).

Brucellosis poses a particular diagnostic challenge in persons from non-endemic regions. A dietary history is important in evaluating for the possibility of brucellosis among individuals who live in non-endemic regions because the disease may be acquired through ingestion of infected foods shipped from regions of endemic disease. Ingestion of unpasteurized milk from cows or goats enhances risk of infection in both disease endemic and non-endemic regions. Physicians, veterinarians, pathologists and laboratory persons are exposed to tissues from infected animals are at particular risk (Bouz, et al.2005). Herders, hunters, farmers, dairy workers, veterinarians and meatpackers exposed to goats, sheep, cows, camels, pigs, reindeer, rabbits, or hares in areas where the disease is not endemic are at greatest risk.

3.0 Materials and Methods

This study used cross sectional survey design and was carried out in Mandera East Sub-county, Mandera County. According to Saunders *et al*., (2007), a cross sectional study is ideal in that it provides a point in time information that captures the opinions, attitudes, preferences, prevalence and factors of interest in research. The study population was made up of 10,458 households in Mandera East Sub-County where each household had on average 6 members. The study was carried out in Central and Khalalio divisions in Mandera East Sub-County, Mandera County. The Sub-county borders Ethiopia to the North, Somalia Republic to the East, Mandera North and Mandera Central Sub-counties to the West and SouthWest respectively and lies approximately 3.94^0 North latitude and 41.86^0 East longitudes (Appendix VII).

Mandera East Sub-county was purposively selected while Simple random sampling technique was used to select two divisions the Central and Khalalio divisions as shown in Table 1. Simple random sampling was then used to determine two locations from each of the selected divisions. Four locations, the Central and Fiqo from Central Division and Khalalio and Bella from Khalalio Division were selected. All households were involved in the study until correct sample reached. Household heads were selected into the study and where not present, any other eldest member of the family who was mature was selected to participate in the study. Key informants included Mandera County Director of Public Health Services, Director of Veterinary services laboratory technologists pharmacists in Public and Private facilities

Table 1: The Sample Frame

County	Sub county	Division	Location	Households in the population	Households in a Sample s
Mandera	Mandera East	Central	Central	740	118
			Fiqo	580	95
		Khalalio	Khalalio	602	97
			Bella	695	110
Total				2617	420

Source: Researcher (2016)

Vol. 3, No. 06; 2019

ISSN: 2581-3366

Adult men and women who had lived for at least six months in the area and consented to participate were selected and enrolled into the study. All study participants were interviewed using a questionnaire which included demographics, risk factors and clinical symptoms for brucellosis. The questionnaires were pre-tested at Takaba in Mandera West in October 2014 and were revised to extended study to improve understanding of questions and to eliminate overly-sensitive questions.

4. 0 Results and Discussion

Demographic characteristics

The overall mean age was 44± 13years (range 15–87) and median 44 years. About 29.3%of the respondents were aged between 35-45 years where 86.2% were males (Table 2).

Table 2: Sociodemographic characteristics of the respondents

Attribute	Category	Frequency (N)	Percent (%)
Age groups	15-25	15	3.6
	25-35	91	21.7
	35-45	123	29.3
	45-55	112	26.7
	55-65	54	12.8
	>65	25	6.0
Gender	Male	362	86.2
	Female	58	13.8
Marital status	Single	14	0.3
	Married	371	88.3
	Separated/ Divorced	24	0.6
	Widowed	11	0.3
Religion	Muslim	385	91.7
	Christian	35	8.3
Level of education	Never been to school (Informal Education)	22	5.2
	Never completed Primary school	135	32.1
	Completed Primary School	162	38.6
	Never completed Secondary school	74	17.6
	Completed Secondary School	21	5
	Post-Secondary School Education	6	1.4
Occupation	Pastoralist	210	50
	Agro-pastoralist	27	6.4
	Farmer	14	3.3
	Formal employment	8	1.9
	Unemployed	161	38.3

The study showed that majority of the respondents (58.3%) were married, 91.7%practiced Islam faith, and 38.6% had completed primary school while half of them were pastoralists (50%) (Table2).

Vol. 3, No. 06; 2019

ISSN: 2581-3366

Factors associated with spread of Brucellosis among the community members

4 Animals respondents directly get contact with

The respondents were asked to state the animals they were most in contact with and the results are presented in figure 1. Almost all respondents 99% (n= 414) were in contact with goats while other contact animals included wild animals such as antelopes. Some of these animals if infected with Brucellosis are likely to transmit it to the residents in the study area. However there was no significant association between getting into direct contact with animals and respondents' RBPT status ($\chi 2=10.576$; df=6; p=0.102) or SSAT status ($\chi 2=5.159$; df=6; p=0.524).

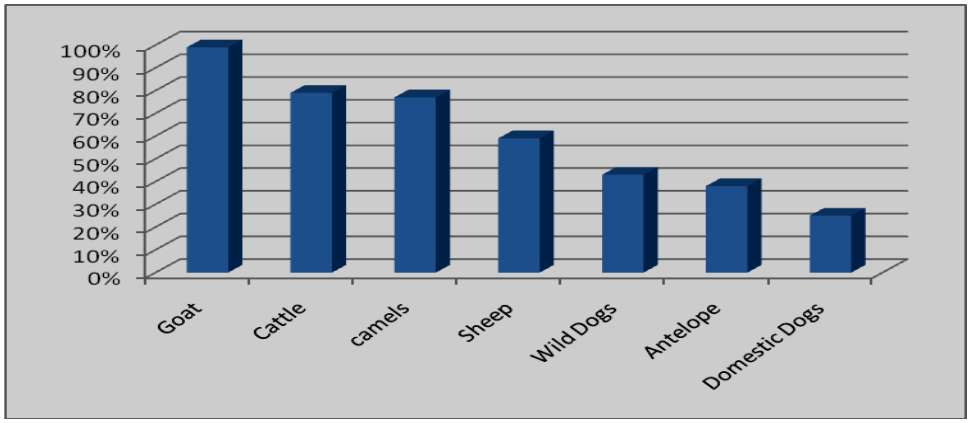

Figure 1: Proportion of respondents who directly get into contact with various animals

Source: Study Data (2016)

Milk handling and preparation practices

Milk handling is an important risk factor in transmission of brucellosis hence milk handling practices were explored among the respondents and the results presented in figure 4.6.

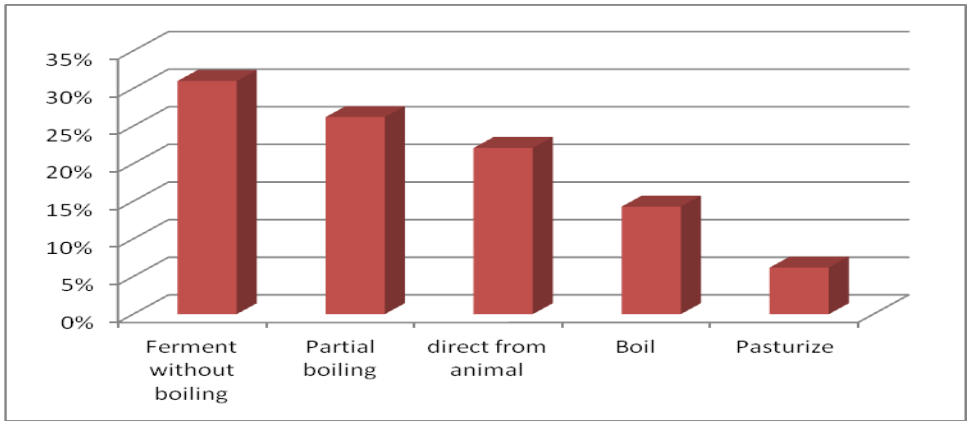

Figure 2: Milk handling and preparation practices

Source: Study Data (2016)

The study showed that 31% (n=130) fermented milk without boiling, while only a few (6%; n=25) respondents pasteurized. There was a significant relationship between the respondents'

milk preparation practices before consuming and brucellosis status using RBPT (χ^2=17.115; df=4; p=0.002) but not when tests were done through SSAT (χ2=8.737; df=4; p=0.068).

Table 2: Relationship between proportion respondents affected by various factors and RBPT or SSAT status

Variable	RBPT			SSAT		
	Negative	Positive	Significance	Negative	Positive	Significance
Animals in direct contact						
Goats	84(84.8%)	15(15.2%)	χ2=10.576; df=6; p=0.102	11(90.9%)	9(9.1%)	χ2=5.159; df=6; p=0.524
Cattle	52(65.8%)	27(34.2%)		8(81%)	15(19%)	
Camel	56(73.7%)	20(26.3%)		8(82.9%)	13(17.1%)	
Sheep	43(72.9%)	16(27.1%)		6(88.1%)	7(11.9%)	
Wild dogs	33(76.7%)	10(23.3%)		4(81.4%)	8(18.6%)	
Antelopes	27(69.2%)	12(30.8%)		4(87.2%)	5(12.8%)	
Domestic dogs	20(83.3%)	4(16.7%)		3(87.5%)	3(12.5%)	
Total	316(75%)	104(25%)		44 (42%)	60(58%)	
Milk preparation before consuming						
Ferment without boiling	104(80%)	26(20%)	χ2=17.115; df=4; p=0.002	14(44%)	18(56%)	χ2=8.737; df=4; p=0.068
Partially heating milk	93(84.5%)	17(15.5%)		12(57%)	9(43%)	
Consume without boiling	60(64.5%)	33(35.5%)		10(36%)	18(64%)	
Thoroughly boiling	43(71.7%)	17(28.3%)		6(43%)	8(57%)	
Pasteurization of milk	15(57.7%)	11(42.3%)		2(22%)	7(78%)	
Total	316(75%)	104(25%)		44 (42%)	60(58%)	
Preparation of meat before consuming						
Taken raw	132(77.6%)	38(22.4%)	χ2=2.899; df=2; p=0.235	18(44%)	23(56%)	χ2=1.426; df=2; p=0.490
Roasted	125(71%)	51(29%)		18(38%)	29(62%)	
Thoroughly Cooked	58(79.5%)	15(20.5%)		8(50%)	8(50%)	
Total	316(75%)	104(25%)		44 (42%)	60(58%)	

Source: Study Data (2016)

Meat Preparation practices before consumption

Meat preparation practices before consumption is an important risk factor in the infection of brucellosis and the results are presented in figure 3. The study showed that most of the residents 42%, (n=176) took roasted meat while 17%, (n=71) took raw meat, a practice that is socially acceptable in the community.

Vol. 3, No. 06; 2019

ISSN: 2581-3366

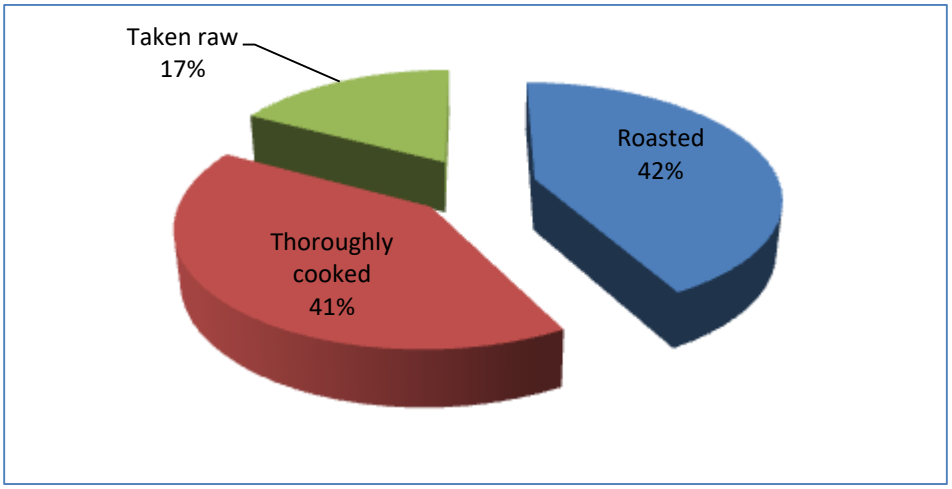

Figure 3: Proportion of respondents who prepared meat variously before consuming
Source: Study Data (2016)

However there was no significant relationship between respondents' method of meat preparation and RBPT status ($\chi 2=2.899$; df=2; p=0.235), or SSAT status ($\chi 2=1.426$; df=2; p=0.490).

Livestock Losses experienced by respondents

The respondents were asked the types of losses they experience with their livestock in order of priority and the results presented in figure 4. Majority (44.8%, n=188) stated that sterility was the lead cause of livestock losses. Other losses were experienced through abortion (34.5%, n=146) and reduced milk production (20.4%, n= 86). However, the type of livestock loss experienced by respondents was not associated with their Brucellosis test status using RBPT $\chi^2=5.435$; df=3; p=0.143) or SSAT ($\chi^2=0.651$; df=3; p=0.885)

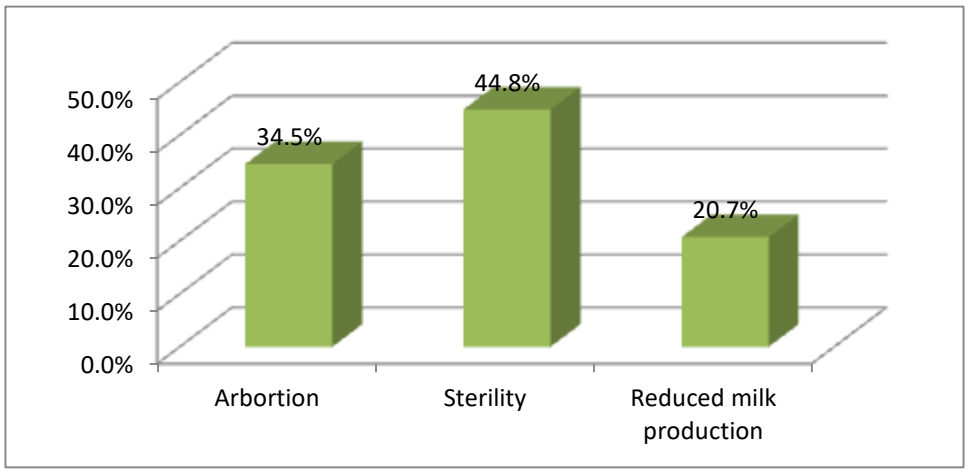

Figure 4: Proportion of respondents who experienced various types of Losses of their Livestock

Source: Study Data (2016)

Vol. 3, No. 06; 2019

ISSN: 2581-3366

Getting into direct contact with animals was found to be one of the risk factors of Brucellosis transmission. This is consistent with observations made by Jones et al., (2010) that nearly two-thirds of human pathogens are zoonotic and, of greater concern, nearly three-quarters of emerging and re-emerging diseases of human beings are zoonoses. It is Nicoletti(1992) who stated that nearly every case of human brucellosis has an animal origin and endemicity of the disease in animals poses a continuous risk for human infection. A study by Kenneth et al., (2009) indicated high brucellosis prevalence among the study participants who had handled animals or their products in one way or the other.

Majority of respondents who didn't have contact with livestock tested negative implying that professions associated with livestock increased the risk of brucellosis infection. These results are consistent with studies performed in Sub-Saharan Africa that suggest that cattle are a significant source of *Brucella spp*. for humans, if not the most important one. It remains to be known if cattle are mainly infected with B. *Melitensis* (which is documented in North Africa) or with *B. abortus* like documented in Zimbabwe or with both *Brucella* species like recently described in Kenya (Godfroid, 2013).
Respondents mostly had direct contact with goats, sheep, cows, camels and other non-food animals which increased probability of infection as indicated by Nicoletti, (1992) and Tzaneva et al., (2007) where nearly every case of human brucellosis has an animal origin.

Results from key informant interviews indicated that animal afterbirths are not properly disposed but are just left to rot or be fed on by scavengers. Fewer respondents immediately disposed placenta after livestock abortion or full term parturition by burying or burning. This increased the risk of infection as large quantities of the bacteria are excreted with the foetus, placenta and the uterine fluid, mainly at the time of calving. After an abortion or parturition, the organism continues to be excreted mainly via milk of infected cows serving as continued source of infection to humans (Mangen et al., 2002). Human to human transmission and congenital infection have also been documented (Frank et al.,1993; Oded et al.,2007). It is usually recommended through World Animal Health Organization that those who work as veterinarian, laboratory (microbiologist) and in slaughterhouses be protected from inoculation with *Brucella* through aerosolization of fluids, contamination of skin abrasions and splashing of mucous membrane by use of protective gear and gloves which is a good precaution measure as exposure through breaks in the skin, following direct contact with tissues, blood, urine, vaginal discharges, aborted foetuses or placentas are also possible routes of transmission of the disease (Gerald et al., 2009).

Another risk factor which was found among the members was consuming milk which is not properly prepared. Many respondents fermented and consumed milk without boiling or pasteurizing it. These results were consistent with previous studies Geoffrey et al., 2002; Kenneth et al., 2009; Mutanda et al., 1998) who noted that unprocessed milk from the market and consuming it raw were independently associated with brucellosis. Mode of milk preparation before consumption contributed to the prevalence where majority of the infected respondents consumed un-boiled and fermented milk. The prevention of brucellosis infection in humans is a

Vol. 3, No. 06; 2019

ISSN: 2581-3366

major reason for the advocacy of milk pasteurization worldwide. This is in line with findings from Omor et al.,(1999) wherein Kenya, over 85% of marketed milk is not pasteurized and is sold through informal market pathways. As indicated by Kang'ethe, (2000) concerns about human health risks from market pathways need to be addressed in the context of consumer practices, such as boiling, to reduce or eliminate potential infection by milk-borne health hazards, without discouraging the smallholders milk markets. Meat was mostly cooked before consumption, roasted and thoroughly cooked which reduced risk of infection

5.0 Conclusions and Recommendations

The study concluded that the factors associated with spread of brucellosis among the community members in Mandera East Sub-county include directly getting into contact with animals such as goats, cows, wild animals dogs, camels, and sheep and taking poorly prepared milk; consuming raw blood from livestock; taking raw or poorly cooked meat and getting involved in various activities touching on livestock. The study recommends that the contribution of non-conventional livestock species (wildlife such as antelopes) to human brucellosis needs to be addressed by Kenya Wildlife Services. In addition, the study observed that most human brucellosis cases have mainly two different origins: foodborne (milk and milk products) or occupational (farmer, butcher, veterinarian,). If human cases are predominantly found in certain professional categories, it suggests that sanitary measures related to milk and milk products are well implemented. Therefore, the study recommends that control should be enhanced in the reservoir animal species

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