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Occurrences of Dairy Calf Mortality and Morbidity and the Associated Risk Factors in Sululta and its Environs, Central Ethiopia

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Abstract

Calf morbidity and mortality are important causes of economic losses on dairy farms worldwide. A cross-sectional study and clinical observation was conducted from November 2016 to April 2017 with the objective of determining calf morbidity and mortality and to investigate the potential risk factors for mortality and morbidity in Sululta and its environs. A total of 312 respondents engaged in market oriented small holder dairying were interviewed using a structured questionnaire survey about their farm and calf management practices and major calf health problems encountered and diseases that causes mortality. The overall magnitude of morbidity and mortality of calves were 31.0% and 58.37%, respectively. The major calf diseases found were diarrhea (69.34%), pneumonia (16.54%), liver fluke (2.4%), bloat (2.0%), joint ill (2.4%) and other cases (8.04%). Risk factors such as weaning age, breed and awareness of colostrums, feeding of calf and overall farm management were included. In this study 80.3% of calf mortality occurs under age 3 month and 19.42% is above 3 month. Based on laboratory examination, *Salmonella* and *E.coli* were detected from diarrheic calves. *Salmonella* found at rate of 2/29 (3.6%) and *E.coli* found at only genus level. In conclusion, the magnitude of calf morbidity and mortality found in this study were much higher than economically tolerable level and could greatly affect the productivity of the dairy farms through mainly decreasing the availability of replacement stock and production of milk. It is therefore, suggested that implementation of improved calf and farm management practices and proper environmental protection in the study areas would significantly reduce calf mortality and morbidity.

Keywords: Dairy Calf; Diarrhea; Morbidity; Mortality; Pneumonia; Risk Factors

List of abbreviations: E. coli: Eschericia Coli; ELISA: Enzyme Linked Immunosorbent Assay; EPA: Environmental Protection Agency (US); ESAP: Ethiopian Society of Animal Production; FAO: Food and Agriculture Organization; MOSH: Market Oriented Small-holder; SFE: Sub Regional Office for Eastern Africa; SPSS: Statistical Package for Social Sciences software; UNDP: United Nations Development Program

Introduction

Dairy farming is a growing livestock production system in Ethiopia. It is primary source of income for urban and pri-urban poor communities. Because of better availability of milk market, most of the dairy farms are concentrated in urban and pri-urban areas of the country. About 12 to 14% of the world population is estimated to live on dairy farms or within dairy farming households (FAO, 2010) [1]. The increasing human population coupled with increasing demand for food security is a serious challenge for developing countries like Ethiopia. Over 85% of the Ethiopian population depends on subsistence agriculture (mainly crop and livestock production) for their livelihood (UNDP, 2012) [2].

According to Lorenz *et al.* (2011), calf morbidity and mortality have short-term and long-term detrimental effects on performance of a dairy farm. They impair both growth rate and replacement capacity of the herd (MacGurik and Ruegg, http://www.progressivedairy. com/dairy-basics/calf-and-heifer-raising/2230-0209pd-calf-diseases-and-prevention.referred in November 2013). Calf hood diseases have, therefore, a significant financial impact on dairies resulting from treatment costs, genetic loss, and impaired future performance (Donovan *et al.*, 1998). Furthermore, many of the infectious agents that cause calf diarrhea can pose a considerable threat to humans (E. coli, Salmonella, Campylobacter, and Cryptosporidium). The prevalence of multidrug resistance among the Salmonella strains has increased over the past two decades (Kevin *et al.*, 2010) causing an increase in treatment failure and hospitalization rates (Swai *et al.* [3], 2010; Varma *et al.*, 2005). Thus, controlling infections caused by these microorganisms in dairy calves can provide economic, health and welfare benefits in the dairy industry and may reduce the zoonotic risk.

Smallholder dairy production is common in many parts of the developing countries, including Ethiopia, serving as an important nutritional source and income to millions of households (World Bank, 2011) [4]. Given the considerable potential for smallholder income and employment generation from high-value dairy products development of the dairy sector in Ethiopia can contribute significantly to poverty alleviation and nutrition in the country (Staal *et al*., 2001) [5].

The success of any breeding program as well as the future of the smallholder dairy farms depends upon the rate of survival of calf crop produced and accordingly calf morbidity and mortality are of great concern of dairyman, because most of the dairy farms are confronted with acute problems of calf morbidity and mortality (Wudu *et al*., 2008 [6]; Gitau *et al*., 2010) [7]. Smallholder dairy farmers experience high calf mortalities which can go up to 50% (Moran, 2011). Shortage of dairy replacement heifers is one of the major hindrances to the development of smallholder dairy production in developing countries (Bebe, 2008) [8]. Mortality rate in dairy calves varied from a low of approximately 2% to high of 20% with mortality on individual farm va Calf diseases that cause mortality are the results of complex interaction of the management practices, environment, infectious agents and the calf itself. Implementation of improved calf management practices is greatly suggested to reduce the high level of calf disease problems (Wudu *et al*., 2008) [6].

- To identify most predominant cause of mortality and morbidity of the dairy calf on study the area.
- To assess the impact and the consequence of mortality and morbidity of the dairy calf on the production of farms and smallholders dairy farmers.
- To estimate the mortality and morbidity of dairy calf in pri-urban Addis Ababa, particularly Sululta and its vicinity.

Materials and Methods

Study Population

All calves from the smallholder dairy farms in Sululta and its surrounding constituted the study population. As the description of office of ruler development the area holds 270,778 cattle and 22,169 calves in 2008 and 65% of the population practiced small dairy production per Kebele, a local administrative unit. There were 5 intensive dairy farms with milking herd size of greater than 20 and a lot of market oriented smallholder (MOSH) dairy farms with herd size of around three cows. The majority of MOSH dairy farms were unorganized with any market system or Milk products marketing cooperatives, plc.

Study Design

A cross-sectional study and clinical observation was conducted for the duration that extended from beginning of November 2016 to the beginning of April 2017. The sampling unit was based on the presence of calves in those dairy farms and thus the study farms were individually identified.

Study Animal and Sampling Technique

Study animals were cross bred dairy calves, Local Zebu and exotic of pre-weaning age in Sululta and its environs. A cross-sectional study was carried out to determine the morbidity, mortality and major health problems of calves. Study sites and households were selected purposively based on the availability of calves and geographic locations. A total of 312 respondents who owned calves of pre- weaning age (below 12 months) were sampled and interviewed.

Data Collection

A structured questionnaire which has been composed of various questions focused on calf management and health concerns was administered to 312 households. Clinical observation was carried out on the presented calves. Major risk factors including awareness of colostrums, feeding type, availability of treatment for the calf, weaning age, housing system and different variables related with management system were covered during the interview. Data on history of calf deaths, illness, and type of feeds and health care and also major farm problems were also recorded. Major syndromes of diseases of calves were recorded during the data collection process and were summarized and categorized in to five disease conditions/syndromes based on owners' traditional disease description knowledge with cross referenced to scientific disease interpretation.

Fecal Sample Collection

Faecal samples for bacterial culture and isolation was collected from 29 diarrheic calves for five consecutive days of the onset of diarrhea. A calf was considered as diarrheic if faces were semi-fluid (loose) to fluid with or without mucus and/or blood. About 20 to 30 grams of faces were collected directly from the rectum of affected animals with a sterile latex surgical glove and placed into a plastic bag.

Samples were intended to examine for the presence of *E. coli* strain K99 and *Salmonella*; however, due to the problem encountered to secure the ELISA kit for *E. coli* strain K99, *E. coli* was isolated only at the species level. The bacteriological examination was carried out according to standard methods (Quinn *et al*. 2002) [9,10].

Results

Description of Farms and Calving Management Based on Questionnaire Result

All the farms included in this study were under extensive system of production. Farmers kept exotic, cross breed and local breeds. With the exception of 3 farms, which exercise stall feed, all farms were completely exercised grazing. Depending on the interviewing in most MOSH dairy farm; male calves were sold soon after birth. Naval treatment during birth of calves was practiced in only 12/312 (3.84%) of the farms.

Although based on the response of the farmers, 100% of MOSH dairy farms had an awareness on the importance of the colostrums and the advantage of colostrums over the ordinary or milk replacer feed. In all visited farms fed the calf two times per day. There is no any starter feed that was used for calves after the weaning age. The feeds used included straw, hay etc. The weaning age varied from farm to farm. Most farms which were 93.3% wean their calves at above 6 month. The remaining farms wean their calves at below 6 month.

Bedding was not provided for calves in all the MOSH dairy farms. Sululta MOSH dairy farms call private veterinary practitioners, whenever facing health problems of animals. The farms practiced dam vaccination or any other measures to protect future calf morbidity and mortality. Of the 312 MOSH dairy farmers interviewed, 243 (77.88%) of them mentioned calf morbidity and mortality as one of the health problems in their farms. For MOSH dairy farms, calf mortality was number one problem. (For the rest of the farms either reproductive problem or mastitis was the first complaint). Some 68.3% Sululta and its environs MOSH dairy farms had experienced the death of at least one calf in the past year. From farmers that mentioned calf health problems as a problem in dairy production the majority of them (69.34%) complained diarrhea as a major cause of morbidity and mortality.

The details on the overall of the respondents' feedback on their demography and dairy farm management practice in Sululta and its environs are presented in (Table 1). Similarly, Table 2 also shows the respondents' feedback on the calfs health and management situations in those farms.

Variable	Description	Frequency	valid per cent
Education Status	Illiterate	114	36.7
	read and writes	59	19.0
	Primary	84	27.0
	Secondary	48	15.4
	Professional	4	1.3
Farm type	Dairy	235	75.3
	Beef	7	2.2
	Mixed	70	22
Water source	Pipe	40	12.8
	Carry	272	87.2
Age of farm	≥ 5 years	302	96.8
	≤ 5 years	10	3.2
Breed	Local	192	61.7
	Exotic	18	5.8
	Both	102	32.5
Sex of farm Attendant	Male	239	76.6
	female	73	23.4

Table 1: Respondents feedback on their demography and dairy farm management practice in Sululta and its environs

Variable	Description	Frequency	valid per cent
Weaning age	≥ 6 month	21	6.7
	< 6 month	291	93.3
Bedding	Present	21	6.7
	Absent	291	93.3
Availability treatment for died calf	Yes	154	49.2
	no	92	29.5
	no death	66	21.1
Naval treatment	practice	12	3.8
	Not practiced	300	96.2

Table 2: Respondent feedback on calves health and management in Sululta and its environs

According to the data indicated in the study area, there was more literacy (36.7%) of the farmers and four respondent professionals were recorded. All the interviewing respondents use their farm as a primary source of income and all recorded farmers have above 5 years farm experience. Almost in all the study areas uses the same farm management.

According to the calving management all interviewed framers have calving facilities and have traditional awareness of the importance of colostrums to neonates. The farmer's commonly use mud as calf bedding but the 93.3% of respondents have no proper bedding. Most farms (93.3%) wean their calves in above 6 month. All farms feed their calves' only milk. Farmers in the area have not introduced any milk replacer to feed calves. The frequency of the feeding period was two times per day and the total amount of milk fed was four litters, which was during day and night.

Major Cause of Calf Mortality and Morbidity

Disease was the sole cause of calf mortality in the study dairy farms. Among disease conditions/ syndrome inferred as causes, calf diarrhea was the predominant cause of calf loss (69.34%) followed by pneumonia (16%). The other causes of death were including bloat, naval ill and fluke. The mortality distribution by age showed 1-3 months of age indicating higher mortality of calves at early age. Details on distribution of the major cause for calf mortality in Sululta and its environs are presented in (Table 3). Similarly, the proportion and causes of calf morbidity among the dairy farms in Sululta and its environs are shown in (Table 4). Laboratory findings associated with agents of diarrhea from samples taken from Sululta and its environs, indicating two positive cases for Salmonella test is also presented in (Table 5).

Factors	N	Proportion
Diarrhea	659(457)	69.34
pneumonia	659(109)	16.54
liver fluke	659(16)	2.4
Bloat	659(13)	2.0
joint ill	659(16)	2.4
Other factor	659(53)	8.04
Died Age less than 3 month	659(529)	80.27
Died Age greater than 3 month	659(128)	19.42

N=number of died calves

Table 3: Distribution of major cause for calf mortality in Sululta and its environs

Factors	N	Frequency	Proportion
Diarrhea	312	209	66.8
pneumonia	312	64	20.5
Fluke	312	10	3.20
Bloat	312	16	5.12
Naval ill	312	13	4.16
Other factor	312	38	12.2

N = number of farms

Table 4: Proportion and causes of calf morbidity among the dairy farms in Sululta and its environs

Age (month)	No. of calf (%)	Salmonella
> 3	20(68.96)	2
<3	9 (31.03)	0

Table 5: Laboratory findings associated with agents of diarrhea from samples taken from Sululta and its environs

Discussion

This study attempted to determine dairy calf morbidity and mortality, identifying the importance and magnitude of the factors that put dairy calves at risk of morbidity and mortality, and isolating some of the pathogenic agents that caused diarrhea in the calves. The overall morbidity and mortality recorded in this study were 31.0% and 58.37 respectively. This result is far close to the findings of Wudu *et al.* (2008) [6], where the crude dairy calf morbidity was 62.0% and mortality 22.0% and with the finding of Asefa and Ashenafi, (2016) [11], where the overall morbidity and mortality recorded in this study was 66.7% and 20%, respectively. Although diarrhea was the most important cause of morbidity and mortality in both studies, the prevalence of diarrhea in this study was higher (63.3 %) than the prevalence of diarrhea indicated by Wudu *et al.* (2008) [6], which was, 42.9 %. The outcome of this study confirmed the finding of Gulliksen *et al.* (2009) [12] that diarrhea was the most frequent health disorder of calves.

Age specific mortality in this study was inversely related with age, higher in the first 3 months of age and declining gradually. This could be explained by failure of passive immunity in hand feeding practices and high susceptibility of new borne calves to many of infectious diseases causing diarrhea and pneumonia (Quinn *et al.*, 2002) [9,10].

Calf disease that causes mortality is the results of complex interaction of the management practices, environment, infectious agents and the calf itself. The major surveyed calf diseases/ syndromes were diarrhea (69.34%), pneumonia (16.54%), bloat (2%), joint ill umbilical abscess (2.4%), liver fluke (2.4) and other cases (8.4%). The calf diarrhea was the leading cause of calf mortality followed by pneumonia which is in agreement with the previous reports, Awol *et al.* (2016) [13] found 44%, Asefa and Ashenafi (2016) [11] found 63.2% and Bekele *et al.* (2009) also [14]. Found 39%. Generally, these high occurrences of diarrhea are higher than the report of Wudu *et al.* (2008) [6], which ranged between 26.44 % and 42.9%.

The results of the present investigation showed that, the morbidity and mortality of calves was unlike to other studies reported throughout the country, in which case the mortality were generally higher than the morbidity. According to the present findings, most of the calves showed clinical signs only for hours or a day. In the study area, there was a Known Skin and Hide Factory and the factory reportedly disposed the waste products to the local river where most livestock owners experienced and use for grazing.

This polluted river causes sudden death mostly to the calf and other livestock. Mostly calf which used the polluted water show clinical signs with acute watery blackish diarrhea. After the death of calves some farmers experienced opening the abdomen and during this time, the stomach was found blackish and the lung was found like toasted meat. Based on environmental protection agency, turning skin into leather also requires massive amounts of energy and dangerous chemicals, including mineral salts, formaldehyde, coal-tar derivatives, and various oils, dyes, and finishes, some of them cyanide-based. Most leather produced is chrome-tanned; all wastes containing chromium (a toxic and affect the aquatic life) element is considered hazardous by the EPA. Tannery effluent contains large amounts of pollutants, such as salt, lime sludge, sulfides, and acids. Arsenic, a common tannery chemical, has long been associated with lung cancer. The production of leather, skin and hide hurts animals (especially small animals like calf and small ruminants), the environment, and the workers who manufacture and the farmers in the affected areas.

Calf diarrhea as a leading health problem in growing dairy calves is a common finding. Works revealed that calf diarrhea is common in the three month of life. The high incidence of mortality in this study suggests the significance improving farm management and failure of adequate nutrition to calves. Previous reports indicated that viruses such as rotavirus and corona virus, enterogenic bacteria particularly *E.coli* and *salmonellosis*, and protozoal infections such as *cryptosporidium* and *coccidia* were incriminated as causes of diarrhea and consequent mortality at early age (Aiello, 1998 [15]; Gillespie, 1998 [16];Quinn *et al*., 2002 [9,10]; Trotz-Williams *et al*., 2005 [17], Wudu *et al*., 2008 [6]). Out of 29 fecal samples collected from the diarrheic calves, only two (6.89 %) were *Salmonella* positive. Sero-typing of the isolated E. coli was not performed due to failure of securing a kit. *E. coli* can be isolated from healthy calves and adult cows as well as calves with diarrhea. It can be normal intestinal flora. This creates uncertainty if the *E. coli* recovered from the samples could serve as a causative agent to the disease. However, based on the clinical signs shown by the diarrheic calves and the report by the Rural Development of Chancho Administration Office associated with the City Veterinary Clinic, and the prevailing situation of the dairy calves' environment, it may be possible to come to conclusion that the most likely cause of the diarrhea problem is Salmonella.

All calves kept on mud floored farm give uncomfortable environment to calves and illness. This might be because of the difficulty in keeping mud floors clean and dry. Besides, they were also none effectively disinfected. As reported by Lindsay (2012) [18], muddy, wet conditions have proven to be the source of increased morbidity because the disease causing bacteria can grow rapidly. The most important determining factor of whether a herd had high or low calf morbidity and mortality is the quality of calf management. In hundred percent's of the surveyed farms, dairying and cattle rising served as the primary source of income to the owners. Farmers working in farms with less number of animals will have much less income from the farm. Thus, they spent much of their time on working with their farm but due to less modernize mechanisms the mortality and the morbidity number is still high. This poor caring and low quality availability of treatment for sick calves might result in the significantly high mortality.

In the current study, 312 (100%) of the calves were kept in separated barn. Separate barn provide an opportunity for the farmer to feed, clean, and monitor the calves. Calf diarrhea was reported by the farmers as the most common disease conditions in the calves. This is in agreement with other report (Lemma *et al*., 2001). From the present study beyond the contaminant and polluted water, it was found that hygiene was significantly associated with the health of the calves. The higher risk of morbidity was associated with the dirtiness of calf house, poor management of the farm and inadequacy of availability of treatment for the sick calf. This finding is in agreement with the results of Shiferaw *et al.* (2002) [19] who reported the effect of the micro environment of calves as affecting the occurrence of calf mortality and morbidity in Holleta Ethiopia. Bendali *et al.* (1999) [20] also reported that uncleaned calf housing, as being associated with high risk of calf scour. Farmers frequently disposed of dung and waste materials in the area around or near to the animal housing which often resulted in unhygienic calf rearing conditions; this is likely because in the study area there is no any agricultural activity other than farming that produces and uses the dung like activity of vegetables.

The present study showed that an increased emphasis of farm management, cleanness of the house, well calving management with scientific advice should be in place primarily by veterinary practitioner. Also, in the present study management practices, hygiene and calf house conditions seem to be the major factor for disease occurrence. It has been demonstrated that poor housing, malnutrition and poor disease control strategies are the main factors limiting survival and performance of dairy calves on the farms (Gitau *et al*., 1994). Other factors related to health and survival of calves include overcrowding, failure to keep calves separated into age groups and continual use of the same calf-rearing paddock which can predispose them to scours and other disease conditions

(Roy, 1990). Adequate amounts of high quality colostrum at birth, sufficient quantities of milk or milk replacer, proper weaning management and adequate dry feed intake are all of great importance for the overall survival, growth of young calves and mainly based on the investigation of this study it's better to limit the movement of calves where chemical disposal areas.

Conclusion and Recommendations

In conclusion, the degree of calf morbidity and mortality was found to be relatively high in the examined dairy farms and judged to be much higher than the economically tolerable level for the dairy producers of Sululta and its environs. Especially the mortality was found to be higher than any other studies reported in the Country. This is because of environmental factors, mainly chemical disposal from nearly factories which is considered to have great effect on mortality of calves [21]. It can have short-term and long-term detrimental effects on dairy production by suppressing growth rate and brought a sudden death of the calves and reduce replacement capacity of the herd. The mortality of calving in present study areas unexpectedly high due to a toxicity of the chemical waste from the skin and hide factory which release to the local river. Diarrhea and pneumonia were the main causes of calves death revealed in this study area [22]. Cause-specific mortality rates of these causes were higher than reports so far in other area of Ethiopia. Therefore, based on the above conclusion and present investigation, the following recommendations are forwarded:

- A more related study is suggested to identify the major infectious agents causing diarrhea and pneumonia.
- There must be rule and regulation regarding factories waste disposal to the area which pollute the environment.
- Implementation of improved management practices regarding calving and overall farm management.
- To enhance the production of milk in the study area there must be compensation for replacement stock to those farmers who lost their calves

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