Investigation of Intestinal Parasitic Pathogens and Risk Factors Leading to Infectious Diarrhea Complex in Camel Calves in Selected Districts of Afar National Regional State, Ethiopia
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ABSTRACT
Even though diarrhea is a significant cause of mortality and poor body weight gain in camel calves in Ethiopia, very scanty information is available on its cause and associated risk factors. Hence, a cross-sectional study was conducted from April 2013 to December 2014 with the objective of investigating intestinal parasitic pathogens and risk factors associated with camel calf diarrhea in selected districts of Afar region. A total of 384 fecal samples from diarrheic, convalescent and apparently healthy camel calves aged 12 months or younger were collected and processed using standard conventional assays. Out of the 384 camel calves examined, 246 (64.06%) were diagnosed as harboring one or more GI parasites at varying levels. Strongyl, 47.5% and Trichostrongylus, 19.2% were the leading parasitic species isolated from the GIT of apparently healthy calves. Fecal samples collected from diarrheic calves revealed high prevalence of Cryptosporidium (37.9%) which was followed by Eimeria and Strongyl species each contributed for 27.1% and 16.4% of the total parasitic count, respectively. Analysis of the questionnaire data revealed malpractices in the areas of colostrum feeding, calf barn sanitation and health management, among others, across the studied communities. Age and colostrum feeding were among the major risk factors associated with parasitic isolation and calf diarrhea. Accordingly, young calves (0-3 months old) that didn’t consume colostrum or received small amount of colostrum late in their life were at a significantly high risk of being affected with diarrhea (P<0.05). Furthermore, this study supports the assertion of Cryptosporidium species as being the most important pathogen involved in camel calf diarrhea and has important public health implication. Extension work to advance care to camel calves and ensuring ingestion of adequate colostrum within the first 6 hours after birth is crucial to enhance calf survival.

Key words: Calf diarrhea, Camel, parasitic pathogen, Afar, Ethiopia.

INTRODUCTION
Camel (Camelus dromedarius) is a primary livelihood asset in the arid and semi-arid lands and has a special significance in the life of the pastoralists. Camel provides these communities with tangible benefits (income, milk, meat, transportation, and hides) and intangible benefits (status symbol, insurance, risk aversion and social capital). The pastoralists see camels as a banking system or security against drought, disease, and other natural disasters that affect smaller stock more seriously (Farah et al., 2004).
However, rearing of camels under traditional pastoral production systems is faced with several challenges. A major confront in camel productivity is the high morbidity and mortality rate of camel calves in the early stage which impairs both growth rate and replacement capacity of the herd (Marce et al., 2010). Infectious diarrhoea is among the emerging health hazards to camel calves worldwide, incurring considerable loss of life and production. It is a significant cause of mortality and poor weight gain in calves and contributes to impaired future performance of the herd and the livelihood of the society (Lanz Uhde et al., 2008).

Diarrhoea has been reported to be hindrance to production enhancement and cause of calf mortality by several authors from different pastoral areas, but the contributing factors have not been clearly elaborated. According to Faye et al. (1997) the reason for 68% of the camel calf losses in Niger is diarrhoea, while Bada Alambedji et al. (1992) state that the morbidity of diarrhoea can reach 80 to 90% with a minimum of 50% mortality. The authors stated that diarrhea in camel calves is caused by the synergistic effect of predisposing factors, management practices, deprived colostrum intake, parasites, bacteria and viruses.

Agab and Abbas (1999) stated that diarrhoea is a significant cause of mortality and poor weight gain in camel calves and contributes to slow herd growth in Sudan. It was reported in 21.9% of the investigated calves, with a peak in the early summer. To their knowledge the cause of diarrhoea is not sufficiently known, however parasitic infections and bad management practices are mentioned.

Similarly, a survey carried out in Puntland indicated 73.2% of mortality in newborn camel calves due to diarrhoea (Farah et al., 2007). Dia et al. (2000) stated that diarrhoea is the major cause of death in camel calves according to the herdsmen in Mauritania with more than 80% of calves being affected. Furthermore, many of the infectious agents that cause calf diarrhea can pose a considerable threat to humans.

In Ethiopia, the importance, associated risk factors and control procedures of the disease as well as identification and characterization of the leading pathogens in camel calves’ diarrhea complex have not been properly reported. Hence, entire investigative efforts are greatly in need for the identification of the true cause of the disease so as to design sustainable control strategies.

The present study was, therefore, designed to investigate the intestinal parasitic pathogens and assessment of management as well as herd and calf-level risk factors associated with camel calf diarrhea in selected districts of Afar region.

**MATERIALS AND METHODS**

**Description of the Study Area**

Afar national regional state is located in the northeastern part of Ethiopia 588kms far from the capital. The total geographical area of the region is about 270,000 km². It is geographically located between 39°34’ & 42°28’ East Longitude and 8°49’ &14°30’ North Latitude (CSA, 2008).

This study was conducted from April 2013 to December 2014 in the selected pastoral and agro pastoral residences of Asayita, Dubti, Berehalle and Aba-Ala districts of the Afar region (Figure 1). The region is characterized by an arid and semi-arid climate with low and erratic rainfall. The annual temperature & rainfall is 30-50°C & 200-600mm, respectively (Berhanu, 2008).
altitude of the region ranges from 116 meter below sea level (where the highest temperature (50°C) has been recorded) to 1600 meters above sea level (Assefa et al., 2010).

The total population of the region is estimated at 1.2 million of which 90% are pastoralists and agro-pastoralism (10%) is now emerging following some permanent and temporary rivers on which small scale irrigation has been developed (Afar region public relation office, 2006). Animal husbandry in Afar region is characterized by extensive pastoral production system and seasonal mobility.

**Study Animals**

Suckling camel calves (*Camelus dromedaries*), apparently healthy, convalescent, clinically infected with diarrhea and aged a few days to a year old were used as a source of fecal samples. Every calf was examined clinically and its general physical condition was assessed. Special emphasis was put on mucous membranes, skin turgor to check on the hydration status, inspection of the perianal area for any signs of diarrhea and the inspection for suckling reflex.

**Sample Size Determination**

There was no previous investigation about the prevalence of the pathogens in the study districts. Hence, the average expected prevalence rate was assumed to be 50% for the area within 95% Confidence Intervals (CI) at ± 5% desired accuracy. Subsequently, the number of study animals was determined following the formula published in Thrusfield (2007).

\[
n = \frac{1.96^2 \times P_{exp} \times (1-P_{exp})}{d^2}
\]

Where \( n \)= required sample size, \( d \)= desired absolute precision, \( P_{exp} \)= expected prevalence (50%) Based on this the desired sample size to be collected with 50% prevalence rate, absolute precision value of 5% and 95% confidence interval was 384. Accordingly, a total of 384 fecal samples were collected from calves of different sex, age and health status for parasitic carriage.

**Study Design**

A cross-sectional study was used.

**Sampling Strategy**

The study districts were conveniently chosen to do daily laboratory analysis of fecal samples at Samara and Mekelle research and diagnostic laboratories, due to camel population and previous report of camel GIT infection outbreaks.

About 30% of the peasant associations (PAs) in each of the districts were considered representative to the district and included in the study on the basis of feasibility and affordability. Hence, the PAs were selected purposively based on accessibility to the villages by vehicle or proximity to road, previous and existing report of camel calf GIT problems, awareness of the society and camel population. Individual camel calves from each selected herd were sampled proportionally based on the number found in that area.

Camel herds were visited and sampled early in the morning before they are released to the field. The collected samples were processed soon at Samara/Mekelle research and diagnostic laboratories.
Sample Collection

Approximately 25 ml of fecal material was collected from the rectum of calves by direct digital stimulation using disposable latex gloves and placed in separate sterile containers. The containers were labeled with the required information, kept in an ice box and transported to the nearby Samara/Mekelle veterinary research and diagnostic laboratories on the same day. Faeces were stored at 4°C until processing to slow or stop the parasite’s development and reduce unpleasant odors (OIE, 2008).

Laboratory Investigation

Native Smear: For the parasitological analysis, a loop full of the feces was transferred onto a slide and mixed with an equal amount of normal saline. It was covered with a cover slip, and then examined under the microscope (magnification 10 x 10 and 10 x 40).

Flotation: In order to detect parasitic stages in the faeces, the simple test tube flotation method based on the principle of separating of eggs from fecal material and concentrating them by means of a flotation fluid with an appropriate specific gravity was used. A teaspoon full of fecal material was mixed with the flotation solution, and poured into a glass beaker through a sieve. The beakers were filled to the top with the flotation solution and kept standing for 20 minutes. Three loops taken from the surface were transferred onto a slide and examined under a cover slip under the microscope at magnification 10 x 10 and 10 x 40. Protozoa oocysts and/or helminth eggs found were described.

Culturing: Some parasites have similar eggs. Hence, such parasites were identified by using culturing technique. This was used to identify the larvae of each parasite. The collected faeces were broken up finely using a stirring device, placed in a covered Petri dish and kept at room temperature. The correct consistency was obtained by adding water (if faeces were too dry) and sterile faeces/charcoal (If faeces were too wet). Then it was aerated once a day for 1-3 weeks. Finally larvae were recovered using the Baermann technique. The technique was also used to isolate lungworm larvae from fecal samples. Sedimentation and Modified Ziehl-Neelsen staining techniques were used to identify trematode & Cryptosporidium spp, respectively.

Assessment of Risk Factors for Camel Calf Diarrhea

Management as well as herd and calf-level risk factors associated with diarrhea were observed and assessed during sample collection. Generally, the questionnaire comprised all practices which could have impact on the proper rearing of camel calves. These included colostrum feeding, general health care, hygiene and sanitation of calf pens, occurrence of calf diarrhea as well as disease control measures practiced in the herd. In the current study, almost all of the herd's followed nearly similar management approaches. Hence, no statistical comparison was done for most of the factors and only the potential risk factors including e.g. colostrum feeding, age of calves, health status and herd health measures taken were included in the study. The associations between calf diarrhea and the risk factors were calculated using chi-square at 95% confidence interval.

Data Processing and Statistical Analysis

The data obtained from the study were entered in to Microsoft Excel 2007 spread sheet and transferred to SPSS® Version 20 software for statistical analysis. The results were summarized using descriptive statistics. Percentages were used to express the relative abundance of each
genera/species to the total number of isolates. Furthermore, chi-square test was computed so as to observe the relationship between the variants. A p-value of <0.05 was considered indicative of a statistically significant difference. The degree of association was computed using odds ratio (OR) and 95% confidence interval (CI).

RESULTS

Health Status of Camel Calves Sampled
Out of the 384 camel calves sampled, 196 (51.0%) were apparently healthy and 162 (42.2%) clinically diseased exhibiting frequent passage of loose faeces, soiling of rear quarter, decreased skin turgor, pale mucous membranes, sunken eyeballs, fever, depression, anorexic and loss of weight. The nature of diarrhea contents varied from semisolid to watery. The color of the fluid was mostly yellowish to greenish mixed with blood flakes or mucus. The frequency of defecation also varied from 4 to 9 times per day. The remaining 26 (6.8%) of the camel calves were convalescent.

Isolation and Identification of Parasites
Of the 384 camel calves examined, 246 (64.06%) were diagnosed as harboring one or more GI parasites at varying levels. More than one parasitic species were isolated from 49 (30.25%) fecal samples collected from the diarrheic camel calves, 26 (13.26%) specimens of apparently healthy and 25 (96.15%) of convalescent camel calves. On the other hand, only one parasite was isolated out of the fecal samples investigated from 78 (48.19%) diarrheic, 68 (34.69%) apparently healthy and 1 (3.85%) convalescent camel calves. The remaining 35 (21.61%) and 102 (52.04%) fecal samples examined from diarrheic and healthy calves did not reveal any parasite eggs/larvae.

Isolation Rates of Parasitic Species
In the present study a total of 357 parasitic species were isolated from the GIT of all apparently healthy, convalescent and diarrheic camel calves. The isolates constituted three different classes of parasites including Nematodes, Trematodes and Protozoan (Table 1). Regarding the type of infestation, single parasite infestation (38.3%) was higher than mixed infestation (26.04%) where mixed infection with only two parasites was prevalent in which most of the combinations were Eimeria and Cryptosporidium.

Strongyl, 57 (47.5%), Trichostrongylus, 23 (19.2%) and Strongyloides, 20 (16.7%) were the leading parasitic species isolated from the GIT of apparently healthy camel calves. Whereas, Cryptosporidium, 26 (43.3%) and Eimeria, 14 (23.3%) were the most frequently encountered parasitic isolates in the GIT of convalescent camel calves. Fecal samples collected from the calves with signs of GIT infection revealed that there was a high prevalence of Cryptosporidium which accounted for 67 (37.9%) of the total parasitic isolates. This was followed by Eimeria and Strongyl species each contributed for 48 (27.1%) and 29 (16.4%) of the total parasitic count, respectively (Table 2).

There was no significant difference (P>0.05) in probability of being infected by parasites between male and female camel calves (Table 3). Likewise, prevalence of the parasites did not show significant association among different age groups though higher proportions of severe cases were recorded in younger calves (0-3months). However, health status was found to be a significant factor for the prevalence of GI parasites (P<0.05), with eggs/oocysts being detected more frequently in convalescent and diarrheic calves (Table 3).
Findings of the Questionnaire Survey and Observational Assessment

The results indicated statistically significant association between the occurrence of calf diarrhea and colostrum feeding, time of colostrum feeding and age groups. Accordingly, young calves (0-3 months) that didn’t consume colostrum or received small amount of colostrum late in their life were at a significantly high risk (P<0.05) (Table 4). Furthermore, results of the questionnaire data revealed malpractices in the areas of colostrum feeding, first colostrum feeding time, calf pen sanitation and health management, among others, across the studied communities.

DISCUSSION

Diarrhea in camel calves is a complex, multi-factorial disease involving the physiological factors of the calf, the environment, management, nutrition and infectious agents (Schoenian, 2006; Nasr and Meghawery, 2007; Shulaw, 2009). The present work revealed an overall GI parasites prevalence of 64.06% in camel calves. Some of these Helminth parasites also have zoonotic implication for those who work closely with camels.

Poly-parasitism was observed in 26.04% camel calves examined that every infested calf can have at least more than 2 parasites (2.11) on average and is in agreement with that (2.11) reported by Melesse (1996). A slightly higher rate of poly parasitism (2.47) has been reported by Mohamed et al. (2009) from eastern Ethiopia during their study on influence of internal and external parasites on pre and post weaning performance of camel calves at Errer valley (Haromya University camel research herd). This variation could be a reflection of differences in management systems. Kaminjolo et al. (1993) found that the dissemination of oocysts is favored in intensive and semi-intensive systems than in extensive system. The presence of two or more enteropathogens simultaneously has been suggested to result in the clinical development of infection usually being worse (Hoet et al., 2003).

Information on the incidence of Nematodes, Trematodes and Protozoan in camel calves from the country is limited and none has been published from the region. This study documents the occurrence of Cryptosporidium, Eimeria, Strongyl, Trychostrongylus, Strongyloids and Trichuris infection in camels in the study area and as a cause of diarrhea in new born camel calves. Cryptosporidium was reported to infect both the dromedary (Nazifi, 2009; Razavi, 2009) and the bacteria (Kvac, 2008). The source of infection could be water or herdsman as the parasite is known to be zoonotic (Fayer et al., 2004). However, it is mostly documented from domestic ruminants (cattle, sheep and goats) and limited data is available in other herbivores including camels (Razavi, 2009). The results of the present study revealed that Cryptosporidium infection is also occurred in one-humped camel calves with high prevalence.

In this investigation, Cryptosporidium spp. was isolated from diarrheic and convalescent camel calves at a rate of 37.9% and 43.3% respectively. Similarly, Yakhchali and Moradi have reported the parasite from diarrheic camel calves (16%) and healthy adult camels (10%) in 2012 from Iran. Therefore, camels are healthy carriers and sources of Cryptosporidium infection for human beings and other animals. The infected animals can also shed oocysts into the environment and remain as a source of infection to other animals and humans.

Eimeria spp. has been isolated from all apparently healthy, diarrheic and convalescent calves in this study, with higher frequency from the diarrheic calves (27.1%). Coccidiosis is a disease usually affecting young hosts and mainly occurs when factors such as stress (overcrowding,
weaning or transportation) lead to a decline in the host’s resistance. Most of the hosts are sub-clinically infected after ingesting sporulated oocysts. Hot, humid and unhygienic conditions favour the survival of the oocysts in the environment and lead to a higher infection rate. Oocysts can be shed by these sub-clinical infected hosts over a long period. Carriers can shed the oocysts for months, representing a constant threat and source of infection for generations.

In this study, 47 of the 56 visited herds had unhygienic calf pens. Exposure to a contaminated environment is one of the main causes of calf diarrhea. After birth, calves are directly exposed to contaminated environments which can be influenced by various factors such as the presence of infected animals, overcrowding, contaminated calving lots, and a lack of calf segregation by age (Larson et al., 2004; Larson and Tyler, 2005). These factors usually work synergistically and increase the opportunity for increased duration of exposure to a higher quantity of pathogens.

Camelidae are born agammaglobulinemic because of the lack of placental transfer of immunoglobulins (Tibary and Anouassi, 2001). Camel calves therefore, rely on the immediate immunization soon after birth only through the colostrum, which has a very high concentration of antibodies. It contains crucial components effective against pathogens with different mechanism of action. Therefore, it is vital for the calf to suckle as soon and as much as possible (Nidal, 2012). The absence of colostrum intake is described as a contributing factor to camel calf diarrhoea (Agab and Abbas, 1999). The finding of the current study that calves which did not consume colostrum were at a higher risk of being affected with diarrhea (P<0.05) is in harmony with the above theory.

Unfortunately there is a common belief among many pastoralists in the study area that colostrum causes diarrhea and, consequently, is unsuitable for the newborn calf. As a result, many pastoralists limit the colostrum access to the calf. The wide spread practice of withholding the colostrum from the newborn calves is certainly a critical factor in the frequently reported high calf mortality in pastoral production systems (Kamber et al., 2001).

Physiologically, the observed digestive disorders might be related to the high protein content of colostrum, 14% versus 4% in milk (Abu-lehia, 1989). If large amounts of colostrum are ingested at once, the resulting high amounts of ingested proteins cannot be completely absorbed and/or digested in the small intestine of the newborn and is passed on into the colon. There, these proteins are osmotically active causing water influx, which might lead to the observed diarrhea (Kaske, 1994).

The analysis on the association between amount and time of colostrum given to the calves and occurrence of diarrhea was higher in calves which received lower amount of colostrum late in its life, and the difference was significant. The minimum amount of colostrum needed within the first 12 to 24 hours after birth by camelids is not known and recommendations are made based on research done in calves, which require 100 grams of Immunoglobulin G1 (IgG1) (Kamber et al., 2001; Tibary and Anouassi 2001). Newborn camel calves should receive 10% of their body weight in colostrum, preferably within the first 12 hours after birth, with half of this amount given in the first six hours after birth.

The finding that delayed colostrum intake (later than 6 hours of birth) associated with high risk of diarrhea agrees with reports of Olsson et al. (1993) found that each hour of delay in colostrum ingestion in the first 12 hours of age increased the chance of a calf becoming ill by 10%. Matte et al. (1982) found that 61% of colostral immunoglobulin containing 80 mg/ml of 43 IgG is absorbed in six hours and decreases sharply, thereafter. This indicates that the first six hours are the period in which maximum absorption of colostral immunoglobulin takes place.
Nidal (2012) in his study on camel calf management suggested that if the calves are not able to suck by themselves within 12 hours after birth, assistance from the herdsman is needed as the absorption of IgG after this time decreases significantly. He further recommended that calves which after birth cannot stand up by themselves must be put on their feet at an early stage and led to the udder. If, despite all efforts, a calf has not yet suckled in the first 6 hours after the birth, the dam must be milked and the calf given milk from a bottle. If the dam does not have enough colostrum, and no other camel colostrum is available, then cow or goat colostrum may be used as a substitute (Tibary and Anouassi, 2001).

Gastrointestinal parasites, may assume much more significant role in camel husbandry because parasites not only reduce the productivity and performance of camels but also predispose to other infectious diseases (Borji et al., 2010). The demonstration of pathogenic parasites in convalescent and healthy calves confirms the role of the calves as a reservoir and their faeces as a source of contamination for environment, other animals and humans. Failure to isolate parasites from some diarrheic calves might be due to the involvement of other pathogens such as bacteria and virus.

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Figure 1. Administrative location of Afar region showing the study zones and woredas

Table 1: Prevalence of individual GI parasites in both single and mixed infestation

<table>
<thead>
<tr>
<th>Parasite class</th>
<th>Parasite species</th>
<th>Number positive</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protozoan</td>
<td>Cryptosporidium</td>
<td>98</td>
<td>39.84</td>
</tr>
<tr>
<td></td>
<td>Eimeria</td>
<td>69</td>
<td>28.05</td>
</tr>
<tr>
<td></td>
<td>Strongyl</td>
<td>86</td>
<td>34.96</td>
</tr>
<tr>
<td>Nematodes</td>
<td>Trichostrongylus</td>
<td>45</td>
<td>18.30</td>
</tr>
<tr>
<td></td>
<td>Strongyloides</td>
<td>34</td>
<td>13.82</td>
</tr>
<tr>
<td></td>
<td>Trichuris</td>
<td>18</td>
<td>7.32</td>
</tr>
<tr>
<td>Trematodes</td>
<td>Fasciola</td>
<td>7</td>
<td>2.85</td>
</tr>
</tbody>
</table>

Table 2: Parasitic species isolated from the Gastro-Intestinal tract of camel calves

<table>
<thead>
<tr>
<th>Parasite species</th>
<th>Diarrheic N (%)</th>
<th>Convalescent N (%)</th>
<th>Healthy N (%)</th>
<th>Total N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cryptosporidium</td>
<td>67 (37.9)</td>
<td>26 (43.3)</td>
<td>5 (4.2)</td>
<td>98 (27.5)</td>
</tr>
<tr>
<td>Strongyl</td>
<td>29 (16.4)</td>
<td>0 (0)</td>
<td>57 (47.5)</td>
<td>86 (24.1)</td>
</tr>
<tr>
<td>Eimeria</td>
<td>48 (27.1)</td>
<td>14 (23.3)</td>
<td>7 (5.8)</td>
<td>69 (19.3)</td>
</tr>
<tr>
<td>Trichostrongylus</td>
<td>13 (7.3)</td>
<td>9 (15)</td>
<td>23 (19.2)</td>
<td>45 (12.6)</td>
</tr>
<tr>
<td>Strongyloides</td>
<td>12 (6.8)</td>
<td>2 (3.3)</td>
<td>20 (16.7)</td>
<td>34 (9.5)</td>
</tr>
<tr>
<td>Trichuris</td>
<td>7 (3.9)</td>
<td>5 (8.3)</td>
<td>6 (5.0)</td>
<td>18 (5.1)</td>
</tr>
<tr>
<td>Fasciola</td>
<td>1 (0.6)</td>
<td>4 (6.7)</td>
<td>2 (1.7)</td>
<td>7 (1.9)</td>
</tr>
<tr>
<td>Total N (%)</td>
<td>177 (100)</td>
<td>60 (100)</td>
<td>120 (100)</td>
<td>357 (100)</td>
</tr>
</tbody>
</table>
### Table 3: Prevalence of GI parasites infestation in relation to management and host related risk factors

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>No of calves examined</th>
<th>No of calves positive</th>
<th>Prevalence (%)</th>
<th>Chi-square</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (Months)</strong></td>
<td></td>
<td></td>
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<tr>
<td>0-3</td>
<td>188</td>
<td>125</td>
<td>66.49</td>
<td>2.9940</td>
<td>0.393</td>
</tr>
<tr>
<td>4-6</td>
<td>80</td>
<td>46</td>
<td>57.5</td>
<td></td>
<td></td>
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<tr>
<td>7-9</td>
<td>81</td>
<td>50</td>
<td>61.73</td>
<td></td>
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<tr>
<td>10-12</td>
<td>35</td>
<td>25</td>
<td>71.43</td>
<td></td>
<td></td>
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<tr>
<td><strong>Total</strong></td>
<td>384</td>
<td>246</td>
<td>64.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
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</tr>
<tr>
<td>Male</td>
<td>124</td>
<td>79</td>
<td>63.71</td>
<td>0.0099</td>
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<tr>
<td>Female</td>
<td>260</td>
<td>167</td>
<td>64.23</td>
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<tr>
<td><strong>Total</strong></td>
<td>384</td>
<td>246</td>
<td>64.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Health status</strong></td>
<td></td>
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</tr>
<tr>
<td>Diarrheic</td>
<td>162</td>
<td>127</td>
<td>78.4</td>
<td>48.1620</td>
<td>0.000</td>
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<tr>
<td>Convalescent</td>
<td>26</td>
<td>25</td>
<td>96.15</td>
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<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>196</td>
<td>94</td>
<td>47.96</td>
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<tr>
<td><strong>Total</strong></td>
<td>384</td>
<td>246</td>
<td>64.06</td>
<td></td>
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<tr>
<td><strong>Colostrum feeding</strong></td>
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</tr>
<tr>
<td>Sufficient</td>
<td>119</td>
<td>73</td>
<td>61.34</td>
<td>1.5395</td>
<td>0.463</td>
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<tr>
<td>Small amount</td>
<td>159</td>
<td>100</td>
<td>62.89</td>
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<td>106</td>
<td>73</td>
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<td><strong>Total</strong></td>
<td>384</td>
<td>246</td>
<td>64.06</td>
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<td><strong>First colostrum feeding time</strong></td>
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<tr>
<td>Before 6hrs</td>
<td>151</td>
<td>90</td>
<td>59.6</td>
<td>2.5683</td>
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<td>After 6hrs</td>
<td>126</td>
<td>82</td>
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<tr>
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<td>107</td>
<td>74</td>
<td>69.15</td>
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<tr>
<td><strong>Total</strong></td>
<td>384</td>
<td>246</td>
<td>64.06</td>
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Table 4: Occurrence of calf diarrhea in association with colostrum feeding, first colostrum feeding time, sex and age groups as risk factors

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<th>Risk Factors</th>
<th>Health Status</th>
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<th>P-value</th>
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<td>Diarrheic N (%)</td>
<td>Convalescent N (%)</td>
<td>Healthy N (%)</td>
<td>Total N (%)</td>
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<td>Sufficient</td>
<td>27 (22.7)</td>
<td>5 (4.2)</td>
<td>87 (73.1)</td>
<td>119 (100)</td>
<td>169</td>
<td>43.216</td>
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<td>Small amount</td>
<td>69 (43.3)</td>
<td>15 (9.4)</td>
<td>75 (47.2)</td>
<td>159 (100)</td>
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<td>6 (5.7)</td>
<td>34 (32.1)</td>
<td>106 (100)</td>
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<tr>
<td>Total</td>
<td>162 (42.2)</td>
<td>26 (6.8)</td>
<td>196 (51.0)</td>
<td>384 (100)</td>
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<td>Before 6 hrs.</td>
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<td>12 (7.9)</td>
<td>100(66.2)</td>
<td>151 (100)</td>
<td>191</td>
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<td>8 (6.3)</td>
<td>61 (48.4)</td>
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<tr>
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<td>6 (5.6)</td>
<td>35 (32.7)</td>
<td>107 (100)</td>
<td>173</td>
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<tr>
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<td>162 (42.2)</td>
<td>26 (6.8)</td>
<td>196 (51.0)</td>
<td>384 (100)</td>
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<td>162 (42.2)</td>
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<td>130 (50.0)</td>
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