

Major Reproductive Disorders in Crossbred Dairy Cows under Smallholding in Addis Ababa Milkshed, Ethiopia

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Abstract: Cross-sectional study was conducted in Addis Ababa milkshed between January 2008 and December 2009 with the aim to determine the prevalence of the major reproductive health problems and the associated risk factors in the crossbred dairy cows under smallholding. Cows confirmed pregnant and/ or calved were investigated and body condition scored (BCS); questionnaire surveys and evaluation of the management conditions of the farms were carried out. The sera tested to detect *Brucella* antibody by the use of Rose Bengal Plate Test as screening test and Complement Fixation Test as confirmatory test. There were records of one or more of the clinically manifested reproductive problems diagnosed in an animal and the overall prevalence of observed reproductive health problems was 67.8% (1208/1781). The finding of *Brucella* antibody test conducted in the crossbred dairy cows (n=1413) belonging to smallholder farms (n=295) in the milkshed indicated an overall seroprevalence of 4.7%, with a significant (P<0.05) range of 2.6% in Debre Zeit to 7.1% in Addis Ababa. In the milkshed significantly (P<0.05) high proportional morbidity rates were observed with regard to the prevalence of retained foetal membranes (17%), anoestrus (10.1%) and uterine discharges (9.5%). Similarly, the prevalence of endometritis (6.7%), repeat breeders (6.2%), abortion (5.9%), dystocia (3.1%) and stillbirth (2.8%) was considerably high (P>0.05). Analysis of risk factors showed that except in the case of parity and herd size, the overall prevalence of reproductive disorders was significantly (P<0.05) influenced by location of study farms, BCS of the animals and the shelter/ shade and hygienic conditions of the farms, indicating the influence of management conditions of the farms and nutritional status of the animals. The mortality rate of 2.7% found in the study showed that death of the animals was not a major problem in the milkshed. In conclusion, the highest prevalence of reproductive disorders and the associated risk factors indicate the importance of management related constraints. Additionally, the reduced prevalence of the reproductive health problems in cows observed with better BCS and management conditions suggests the potential returns or benefits in the maintenance of these conditions. In sum, to ameliorate the constraints more focused study on the management and nutrition aspects of the crossbred dairy cows under smallholding is recommended.

Key words: Crossbred cows • Milkshed • Reproductive diseases • Smallholder dairy

INTRODUCTION

In order to increase milk production in the tropical regions of the world, cattle crossbreeding programs have long been used as one of the main strategies and temperate breeds have been introduced in many developing countries [1, 2]. In Ethiopia, as part of the same efforts, the peri-urban and urban dairy business have proliferated; the smallholder

dairy farmers, who own the majority of the crossbred cows so produced, are now serving as the main suppliers of milk and milk by-products to the population [3]. However, closer examination of the production conditions of these producers showed that they have faced several constraints and reproductive problems [4, 5]. Wide spread abortion and high prevalence of specific infectious diseases have been reported in relatively large dairy herds [6, 7].

In the last few decades, as the major epidemic diseases were brought under control, emphasis have increasingly shifted to economically important diseases to the dairy producers and reproductive health problem stands out as the most prominent [8, 9]. Upon closer examination of the reproductive processes in dairy cattle, the postpartum period is the most varied and the most vulnerable to problems and that incidentally coincides with the peak of milk production, uterine involution, resumption of ovarian activity, conception and greater risk to infections [10, 11]. In female cattle the causes of infertility in general are many and bovine brucellosis is the most notable, which impacts the greatest economic damages [12]. Brucellosis in cattle mainly affects reproduction and fertility and known responsible for high rate of abortion, reduced survival of the new born and milk yield; additionally, the disease is frequently associated with retention of foetal membranes and the development of uterine infections [11, 12].

Dairy cows reproduction is affected by a variety of factors and increasing trend of intensification the role of the different aspects of management including nutrition and breeding become significant [13]. Furthermore, in the tropical regions, studies reported diseases, nutrition and high ambient temperatures as stressor conditions whereby cows manifest behavioral oestrus of short duration and of poor intensity [6, 14]. Additionally considerable proportion of cows that resume normal oestrous cycle may do so without manifestation of external signs of oestrus [15]. Moreover, those mated cows increasingly experience pregnancy failures, where the contribution of poor oestrus detection as well as the method of services, which can either, is faulty insemination in some ways or natural mating using bulls of questionable fertility [12, 13]. In developing parts of the world, most of the reported studies on the constraints of dairy cattle reproduction focused on the work performed in research stations or institutional herds and thus had little bearing to the production conditions of the flourishing smallholder dairy farms. There is a general paucity of information on the reproductive problems and the associated risk factors of dairy cows in the predominant smallholder dairy production conditions. Therefore, the objective of this study is to describe the occurrence of reproductive health problems in the crossbred dairy cows under smallholding in Addis Ababa milkshed.

MATERIALS AND METHODS

Study Area, Design and Samples: The study was conducted in the central highlands of Ethiopia between January 2008 and December 2009. Cross sectional investigation was performed on dairy farms which were selected using a two stage stratified random sampling procedure to ensure selection of a proportional and representative sample of the smallholder dairy farms under the Addis Ababa milkshed [5]. Clinical observation, serological tests and questionnaire surveys were used as tools to assess the prevalence of the major reproductive health problems of the crossbred cows and the associated risk factors in the milkshed. A total of 295 farms from Addis Ababa, Holleta, Debre Zeit and Sululta and Muka-Turi were identified. This selection was based on the previous work aimed at characterization of the different dairy production sub-systems in the regions [4].

Addis Ababa: Is the capital city and lies in the central highlands of Ethiopia at an altitude of about 2500 m above sea level. The average annual temperature and rainfall are 21°C and 1800 mm, respectively.

Holleta: Is located 45 km away from Addis Ababa in the south west direction, 9°3' N and 38°3' E, at an altitude of 2400 m above sea level in the central highlands. The area is characterized by mild sub tropical weather with the minimum and maximum temperature ranging from 2 - 9°C and 20 - 27°C, respectively. The area receives annual rainfall of 1200 mm.

Debre Zeit: Is located 50 km south-east of Addis Ababa, 8°44' N and 39°02' E, at an altitude of 1880 m above sea level. The area receives mean annual rainfall of 865 mm in a bimodal distribution with mean minimum and maximum annual temperatures of 15°C and 28°C, respectively.

Sululta and Muka-turi: Towns are situated in the northwest direction from Addis Ababa, at a distance of 25 km and 80 km respectively. The area is situated between 9° to 10° N and 37°57'–39°33' E. The mean annual rainfall is 1026 mm and the daily mean maximum and minimum temperature are 20.68 and 11.23°C, respectively.

The milkshed as a whole experiences a bimodal rain fall pattern; the short rainy season lasts from March to May. A long rainy season extends from June to September followed by a dry season from October to February.

Study Animals and Management: The animals were crossbred cows between Friesian and local Zebu. The proportion of exotic blood in these animals ranged from 75 to 87.5%. The cows under smallholding were managed in stalls and were fed teff straw (*Eragrostis tef*) supplemented with a mixture of wheat bran, noug cake (*Guizotia abyssinica*) and/or cotton seed cake at an estimated amount of 5 kg/head/day. Oestrus detection was carried out by herdsmen and cows observed in oestrus were artificially inseminated or hand-mated by high-grade or purebred Friesian bulls. Hand-milking after a brief stimulation, commonly by the calf, was practiced twice daily. Animals were regularly vaccinated against contagious bovine pleuro-pneumonia, anthrax and blackleg.

Clinical Investigation and Questionnaire Survey: Veterinarians visited the study farms and clinical investigation of the animals, questionnaire surveys and evaluation of the management conditions of the farms were carried out. Cows confirmed pregnant and/or calved were investigated and body condition scored (BCS) using a scale 1 to 5 at calving [16]. After calving, cows were clinically examined and rectally palpated on weekly basis to determine uterine status, ovarian structures and reproductive problems, until the cow was found pregnant or about two months of calving. Observations were made on retained foetal membranes (when retained longer than 12 hours after calving), uterine discharges, endometritis, abortion, stillbirth, dystocia, anoestrus and repeat breeder. The problems under miscellaneous category included ovarian cysts, nymphomania, metritis, pyometra, mummified fetus, vaginal injury, vaginal and uterine prolapses. All reproductive health problems as well as deaths, with the associated factors were recorded.

Blood Sample Collection: About 10ml of blood sample was collected from the jugular vein of each cattle using plain vacutainer tube. Each serum sample was identified by labeling on the vacutainer tube. Blood samples were allowed to clot at room temperature. Then the serum was separated from clotted blood by centrifugation. The separated sera were stored at -20°C until tested by Rose Bengal Plate Test (RBPT) and Complement Fixation Test (CFT).

Rose Bengal Plate Test: All serum samples collected were first screened using RBPT following the procedure described by Alton *et al.* [17]. The antigen used for RBPT

consisted of a suspension of *Brucella abortus* (obtained from Institut purquier 326, Rue de la Galera 34097 Montpellier Cedex 5, France), inactivated by heat and phenol, adjusted to pH 3.65 and colored with Rose Bengal. Briefly, test sera and antigen were left at room temperature for half an hour before the test; 30 μl of each test serum was taken and placed in a clean glass slide, 30 μl of RBPT antigen was added to the side of each test serum using a dropper, then the antigen and the test serum were mixed thoroughly by an applicator. The slide was shaken by hand for 4 minutes. The result was read by examining the degree of agglutination in good light source and when deemed necessary using magnifying glass. After four minutes rocking any visible agglutination was considered as positive.

Complement Fixation Test: Sera that tested positive to the RBPT were further confirmed using CFT. Preparation of the reagents was evaluated by titration and performed according to protocols recommended. Standard *Brucella abortus* antigen S 99 was used as an antigen (CVL, New Haw Weybridg and Surry KT15 3NB, UK). The antigen, control sera and complement were obtained from the Bg vv, Berlin, Germany and 2% sheep red blood cell suspension was prepared before the beginning of the test. In the CFT serum with strong reaction, more than 75% fixation of complement (3+) at a dilution of 1: 5 and at least with 50% fixation of complement (2+) at a dilution of 1: 10 and above were classified as positive [18]. The CFT was performed at the National Veterinary Institute or Animal Health Diagnostic and Investigation Center.

Data Analysis: The prevalence of a reproductive problem per 100 animals was used as a measure of disease occurrence. Proportional morbidity rates were calculated by dividing the number of cases of each reproductive problem by the total number of cases. Seroprevalence of *Brucella* was calculated on the basis of RBPT and CFT positive results divided by the total number of individuals tested. The effects of location, parity (primiparous: 1, pluriparous: ≥ 2), BCS (lean: < 2.5 , medium: $2.5 - 3.5$, fat: > 3.5), herd size ($= 5, 6-10, > 10$ heads of cattle), shelter/shade (present, absent) and hygienic conditions (satisfactory, unsatisfactory) on the prevalence of the total reproductive health problems in dairy cows under smallholding were examined. Weighted means were computed and Chi-square (χ^2) test performed for all the health problems; Fisher's exact test was also used when found necessary. Unless and otherwise indicated, $P < 0.05$ was set for establishing significance of the findings [8].

RESULTS

In this study a total of 1831 cows were investigated; the 50 death cases (mortality rate of 2.7%) observed during the study period were excluded from the analysis. Table 1 shows the prevalence and proportional morbidity rates of the major clinically manifested reproductive health problems in dairy cows under smallholding in Addis Ababa milkshed, Ethiopia. In the study on crossbred dairy cows (n=1781), the prevalence of the all observed reproductive health problems was 67.8% (1208/1781). In the investigation there were records of one or more of the clinically manifested reproductive problems diagnosed and reported in a single animal; the miscellaneous conditions category included cystic ovary, nymphomania,

metritis, pyometra, mummified fetus, vaginal injury, vaginal and uterine prolapses.

Table 3 presents the major clinically manifested reproductive health problem cases in dairy cows distributed over the different locations in the milkshed. Statically significant difference was observed with regard to the cases of retained foetal membranes, anoestrus and uterine discharges.

Table 4 shows the summary of the analysis on the effect of location, parity, BCS, herd size, shelter/ shade and hygienic conditions on the overall prevalence of all reproductive disease conditions in crossbred dairy cows. Except in the case of parity and herd size, the overall prevalence was significantly influenced by the location of study farms, BCS of the animal and the shelter/ shade and hygienic conditions of the farms.

Table 1: Prevalence and proportional morbidity rates of major clinically manifested reproductive health problems in crossbred dairy cows (n=1781) under smallholder farms in Addis Ababa milkshed, Ethiopia

Reproductive health problem	Number of cases	Prevalence per 100 animals	Proportional morbidity rate
Retained foetal membranes	302	17.0	25.0
Anoestrus	180	10.1	14.9
Uterine discharges	169	9.5	14.0
Endometritis	119	6.7	9.9
Repeat breeder	110	6.2	9.1
Abortion	105	5.9	8.7
Dystocia	56	3.1	4.6
Stillbirth	49	2.8	4.1
Miscellaneous*	118	6.6	9.9

*Included cystic ovary, nymphomania, metritis, pyometra, mummified fetus, vaginal injury, vaginal and uterine prolapses

The finding of *Brucella* antibody seroprevalence among the crossbred dairy cows tested (n=1413) in smallholder farms (n=295) is presented (Table 2). The overall seroprevalence was 4.7% and ranged between 2.6% in Debre Zeit and 7.1% in Addis Ababa, with a significant difference between them (P<0.05).

Table 2: Seroprevalence of *Brucella* antibody in crossbred dairy cows under smallholder farms in Addis Ababa milkshed, Ethiopia

	Addis Ababa	Holleta	Debre Zeit	Sululta and Muka-Turi	Total
No. of farms visited	78	63	76	78	295
No. of cows tested	496	280	384	253	1413
No. of RBPT positive cows (%)	39 (7.9)	10 (3.6)	15 (3.9)	13 (5.1)	77
No. of CFT positive cows	35	9	10	13	67
Seroprevalence*	7.1	3.2	2.6	5.1	4.7

* $\chi^2 = 11.327$, P<0.05

Table 3: Occurrence of major clinically manifested reproductive health problems in crossbred dairy cows (n=1781) under smallholder farms in Addis Ababa milkshed, Ethiopia

Reproductive health problem	TotalCases	Number of cases (%)				Significance
		Addis Ababa (n=660)	Holleta (n=376)	Debre Zeit (n= 454)	Sululta and Muka-Turi (n= 291)	
Retained foetal membranes	302	115 (17.4)	48 (12.7)	71 (15.6)	68 (23)	$\chi^2 = 13.846$, P=0.003
Anoestrus	180	86 (13.0)	34 (9.0)	36 (7.9)	24 (8.2)	$\chi^2 = 10.154$, P=0.017
Uterine discharges	169	66 (10.0)	27(7.2)	35 (7.7)	41 (14.1)	$\chi^2 = 11.378$, P=0.01
Endometritis	119	43 (6.5)	29(7.7)	24 (5.3)	23 (7.9)	$\chi^2 = 2.785$, P=0.426 NS ^b
Repeat breeder	110	50 (7.6)	17 (4.5)	28 (6.2)	15 (5.2)	$\chi^2 = 4.532$, P=0.209 NS
Abortion	105	40 (6.1)	25 (6.6)	19 (4.2)	21 (7.2)	$\chi^2 = 3.726$, P=0.293 NS
Dystocia	56	21 (3.2)	16 (4.3)	12 (2.6)	7 (2.4)	$\chi^2 = 2.423$, P=0.489 NS
Stillbirth	49	20 (3.0)	10 (2.7)	11 (2.4)	8 (2.8)	$\chi^2 = 0.387$, P=0.943 NS
Miscellaneous conditions ^a	118	56 (8.5)	20 (5.3)	28 (6.2)	14 (4.8)	$\chi^2 = 6.428$, P=0.093 NS

^aIncluded ovarian cysts, nymphomania, metritis, pyometra, mummified fetus, vaginal injury, vaginal and uterine prolapses.

^bNS = not significant

Table 4: The effect of location, parity, body condition score (BCS), herd size, shelter/ shade and hygienic conditions on the prevalence all reproductive disease conditions in crossbred dairy cows (n=1781) under smallholder farms (n=295) in Addis Ababa milkshed, Ethiopia

Risk factor	No. of observations	No. of cases	Prevalence per 100 animals	Significance	
Location				P< 0.001	$\chi^2 = 55.446$, P=0.000
Addis Ababa	660	497	75.3		
Holetta	376	226	60.1		
Debre Zeit	454	264	58.1		
Sululta and Muka-Turi	291	221	75.1		
Parity				NS	Fisher's exact=0.159
Primiparous	193	125	64.9		
Pluriparous	1549	1083	69.9		
BCS				P< 0.001	$\chi^2 = 51.893$, P=0.000
<2.5	593	439	74.0		
2.5 – 3.5	729	520	71.3		
>3.5	457	249	54.5		
Herd size				NS	$\chi^2 = 2.975$, P=0.226
≤ 5	757	533	70.4		
6-10	652	464	71.2		
>10	320	211	65.9		
Shelter/ shade				P< 0.001	Fisher's exact=0.000
Present	1351	897	66.4		
Absent	409	311	76.0		
Hygienic conditions				P< 0.001	Fisher's exact=0.000
Satisfactory	1303	769	59.0		
Unsatisfactory	594	439	73.9		

DISCUSSION

In the present study the major reproductive health problems of crossbred cows under smallholder farms were assessed and the associated risk factors identified. The prevalence of the total observed reproductive health problems was 67.8% (1208/1781). In other words, the overall finding showed that nearly two out of every three cows were observed with one or more of the clinically manifested reproductive health problems. This finding appears slightly lower than the work reported by Kassa and Lema [19] and much higher than the report of Fekadu [20] with the work on Holstein-Friesian cattle in the Rift Valley region and that of Haftu and Gashaw [21], in western Ethiopia. Upon further examination of the occurrence of the different reproductive problems, the significantly high proportional morbidity rates of retained foetal membranes (25%), uterine discharges (14%) and that of endometritis (9.9%, P>0.05) were found notable. In dairy cows, uterine infections which are the likely causes for most of the uterine discharges and endometritis could have considerable contribution to the high number of the diagnosed reproductive health problems and also subsequent infertility of the affected cows [22].

Bovine brucellosis is an infectious and contagious disease with worldwide distribution and was recorded in 120 of 175 countries studied [23]. The disease is characterized by abortion in the last trimester or birth of unthrifty newborn and orchitis and epididymitis with frequent sterility in the male [24]. The disease is of paramount importance when considering its economic

impacts and at the same time improved dairy production and interventions efforts [25]. In the present study, the seroprevalence of brucellosis in the investigated crossbred cows varied and the range was from 2.6% obtained in farms located at Debre Zeit to 7.1% found in farms in Addis Ababa. There was statistically significant (P<0.05) variation between locations in the milkshed, indicating the possible role of management on the prevalence of brucellosis. Previously, the occurrences of much higher seroprevalence in cattle in different production systems were reported by several workers in Ethiopia [26]. In urban and peri-urban areas around Addis Ababa, Asfaw [7] reported seroprevalence of 8.1% in cattle. Furthermore, in the present study an overall prevalence of 5.9% abortion was recorded and this to some extent exceeded the recommended target for dairy cattle [11]. In a study conducted at Debre Zeit a significant association between seropositivity to brucellosis and management practices was established [27]. Similarly under semi-intensive production system of Bahir Dar milkshed, significant association of *Brucella* antibody seroreactions with the occurrence of abortion and retained fetal membranes was also established [26]. Several factors are identified as predisposing to reproductive tract infections and the prior occurrence of retained foetal membranes, stillbirth and dystocia are considered important [12]. Therefore, in the present study, the occurrence of high rates of retained fetal membranes, uterine discharges and abortion in the milkshed are considered as a strong indication of infectious processes.

In the present study the significantly high proportional morbidity rate of anoestrus (14.9%) and relatively high occurrence of repeat breeders (6.2%), dystocia (3.1%) and a group of conditions under the miscellaneous category indicated the role of management in the occurrence major reproductive problems in the studied milkshed. The cause for these findings might be associated with the different breeding methods used and the insemination techniques followed in the region as a whole [28]. The mortality rate of 2.7% found in the study showed that death of the animals was not a major problem in the milkshed, based on further analysis of the different risk factors, in the present study, except for parity and herd size, the rest of the risk factors showed significant difference. No significant influence of parity of the animal and herd size, on the other hand, could be due to the much broader classification of the age category into primiparous versus pluriparous and the herd sizes (less than 5 heads of cattle, between 6 and 10 and those farms with greater than 10 heads) adopted in the study might have masked widely reported influences [7, 26]. Hence, the location of the farms in the milkshed, the nutritional status of the cows assessed in terms of body condition score at calving and the management aspects evaluated by the shelter/ shade and hygienic conditions of the farms were found to significantly influence the overall prevalence of the reproductive health problems in the milkshed. Reduced prevalence of the reproductive problems were observed particularly with those cows having BCS greater than 3.5 and in those farms living in the presence of shelter/ shade and the hygienic conditions was satisfactory and this is consistent with the previous report and general expectations [23].

In conclusion, in the present investigation, the observation of a considerably high prevalence of reproductive disorders, recorded either singly or in combination and the occurrence of the associated risk factors indicate the importance of management related constraints for profitable production of the smallholding dairy herds in the milkshed and that obviously require improvement [11, 28]. On the other hand, the reduced prevalence of the reproductive health problems and the associated risk factors in the cows observed with better BCS and management conditions suggests the potential returns or benefits in the maintenance of these conditions [23, 13]. Additionally, assessed in terms of BCS of cows at calving, the present findings showed the role of nutrition and the possible return for proper feeding of the dairy cows [12, 13]. In sum, the present findings showed the occurrence of high prevalence of major reproductive

health problems and the convergence of considerable number of the associated risk factors; accordingly to ameliorate the constraints more focused study on the management and nutrition aspects of the crossbred dairy cows under smallholding is recommended.

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