



Prevalence of Brucellosis in Cattle, Goat and Camel (*Camelus dromedarius*) during 2013-2018, Bahri Locality, Khartoum, Sudan

Suhair Sayed Mohammed A/Alrahman

Department of Surgery Obstetrics and Gynecology, College of Veterinary
Medicine University of Bahri, Director of the Teaching Veterinary Hospital, Khartoum North
*Corresponding author: _musu421@gmail.com

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Abstract

This is a retrospective study aimed to investigate the prevalence rate of brucellosis among animals (sheep, goat, cattle, and camels) attending the Teaching Veterinary Hospital (TVH), College of Veterinary Medicine, University of Bahri during the period 2013-2018. A total of 5332 blood samples (73, sheep, 3586, goat, 930, cattle, and 743 camels) were collected from the jugular vein of each animal and serum was harvested and examined for brucellosis using the Rose Bengal Plate Test (RBPR). Results obtained indicated that, there were no positive case in the samples collected from sheep, while 525 (9.84%) positive cases were reported including cattle 203(38.67%), goats 222(42.29%) and camels 100(19.04%). The number of positive cases was significantly ($p<0.05$) lower in cattle in 2016 and higher in goats and camels in 2018 and 2015 respectively. Cattle reported a significantly ($p<0.05$) higher incidence in 2014 and 2015. During 2016, 2017 and 2018 goats had the significantly ($p<0.05$) higher incidence of brucellosis. In cattle, the incidence of brucellosis showed seasonal fluctuations, summer season showed a significantly ($p<0.01$) higher values in 2014; while they were significantly ($p<0.05$) higher during winter season of 2015, 2016 and 2017 and lower in 2018. In goats, the incidence of brucellosis was significantly higher in 2018 during winter and summer ($p<0.05$) and autumn ($p<0.01$). In camels, generally the incidence was significantly ($p<0.05$) higher in winter compared to other seasons. It is concluded that brucellosis is one of the greatest health problems amongst cattle, goats and camels in Bahri locality and winter is the season where brucella is the most common. It is recommended that, a comprehensive brucellosis survey program should be established with advanced diagnostic techniques accompanied with a very restrict government-sponsored policy of vaccination, depopulation and compensation. Epidemiological studies are also needed amongst herders and consumers of animal's products.

Keywords: Brucellosis, cattle, goat, camel, Rose Bengal, Seasons.

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Introduction

Brucellosis is one of the important zoonotic diseases, it is transmitted either directly or

indirectly and it continues to be of worldwide public health and economic concern. The causative bacterium was named in honor of

Sir David Bruce the discoverer of *Br. melitensis*, *Bacillus abortus* was isolated by Bang and it is morphologically and antigenically similar to *Br. melitensis* (Young and Corbel, 1989). There are six species of recognized Brucella, *Br. abortus* (cattle), *Br. Melitensis* (sheep and goat), *Br. Ovis* (Ovine), *Br. Suis* (Swine) *Br. Canis* (Dog) (Scholz and Vergnaud, 2013) and *B. neotomae* (dessert wood rat) (Villalobos-Vindas *et al.* 2017). Latter a marine species has been noted as *Br. maris* (Sohn *et al.*, 2003).

Br. abortus is the cause of contagious abortion in cattle, (Elberg, 1983). The main causative agent of brucellosis in sheep and goat is *Br. melitensis*, but the infection also occurs in cattle, camels and wild animals. Two biotypes of *Br. melitensis* were isolated from a wild alpine apex and chamois in a Natural Park in Italy (Ferroglio *et al.*, 1998). Camel brucellosis can be encountered in all camel rearing countries with exception of Australia. In many developing countries in the arid areas of Asia and Africa, camels are still the most important productive livestock for nomadic populations and are highly susceptible to brucellosis caused by *Brucella melitensis* and *Brucella abortus* (Gwida *et al.*, 2012). There is a marked seasonal variation in the prevalence of brucellosis in the temperate regions during spring and summer (Minas *et al.*, 2007, Dahouk *et al.*, 2007 and Donev *et al.*, 2010). In Iran, Dehkordi *et al.*, (2014) reported a high incidence of brucellosis in bulls semen samples during spring season.

In Sudan *Br. abortus* was reported in Friesian (Bennett, 1943) and local (Dafalla, 1962) cattle. Several studies covered the prevalence of brucellosis amongst different species in different localities (Abu Damir *et al.*, 1984, Osman and Adlan, 1986, El-Ansary *et al.*, 2001, Musa, 2005, Angara, 2005, Omer *et al.*,

2007, Mohammedahmed, 2009, Saad, 2013, Ebrahim, 2013 and Solafa *et al.*, 2014). Camels in Sudan are used to be reared in arid and semiarid lands, Many traditional owners keep camels solely or mainly for milk (Wilson, 2018). Brucella in camel was firstly reported by Musa and Awad Elkarim (1971) and brucella biovar was firstly reported in Sudan by Agab *et al.*, (1994). Now camels' habitat is changed and they are reared side by side with other domestic livestock and wildlife which resulted in exposure of camels to diseases which were uncommon to their natural habitat as brucellosis (Musa and Shigidi, 2001). Camels in the Sudan are not vaccinated against brucellosis (Mohammed and Abdelgadir, 2016). The hallmarks of animals' brucellosis are abortion, infertility and reproductive failure (Philip, 2003). Treatment of brucellosis is limited and its control is achieved by reducing reservoir of infection, quarantine, depopulation and vaccination (Radostits *et al.*, 2000).

Brucellosis is one of the main zoonoses in the world as livestock farmers are exposed to brucella infection which is closely related to the level of infection in the animal population, the level of environmental contamination and hygiene on the farm (Alausa, 1980). Abortion and polluted water sources are risk factors (Solafa *et al.*, 2014). Modified Rose Bengal plate test (RBPT) is one of the tests used in brucella detection as screening and standard tests (Salisu *et al.*, 2017). The Rose Bengal Plate test technique is aiming at detecting antibodies specific of smooth *Brucella* species (especially *B. abortus*, *B. melitensis* and *B. suis*) by the Rose Bengal test in animal sera (ruminants, equidae, suidae, camelidae and carnivores, both wild and domestic, in particular) (OIE, 2008a).

This retrospective study aimed at investigating the prevalence of brucellosis in

cattle, goats and camels in Bahri locality presented to the TVH, College of Veterinary, University of Bahri, since 2014-2018, using Rose Bengal Plate Test.

Materials and Methods

Study Area: The Teaching Veterinary Hospital is situated at North Bahri area, Alkadru, latitude and longitude are 15° 38'N 32° 38' E.

Animals: Clinical cases admitted to the Teaching Veterinary Hospital, College of Veterinary Medicine, University of Bahri for routine examination, natural breeding or abortions complains during 2014-2018, were carefully examined following routine clinical examination procedures.

Methodology: Blood samples were taken from the jugular vein of animals and serum

samples were prepared and examined for brucellosis using The Rose Bengal Plate Test (RBPT) (OIE, 2008a, OIE, 2008b).

Statistical analysis: The statistical analysis was performed using the Statistical System (SAS, 1997). The analysis of variance (ANOVA) to evaluate the effect of season

Results

Out of the total number of animals examined sheep, cattle, goat and camel represented (1.37%, 21.82%, 6.19% and 13.46%) respectively. In 2013 no positive cases were reported, throughout the study period no positive cases were reported in sheep. The total number of positive cases reported was 525 out of which 203(38.67%) was cattle, 222(42.29%) goats and 100 (19.04%) camel (Table1)

Table 1: Total number of Positive Cases of Brucellosis, 2014- 2018

Year	Cattle	Goat	Camel
2014	54	10	9
2015	50	9	45
2016	19	37	31
2017	27	55	0
2018	53	111	15
Total	203 (38.67%)	222 (42.29%)	100 (19.04%)

Figure (1) shows that generally higher incidences of positive cases reported were in goats compared to the other species.

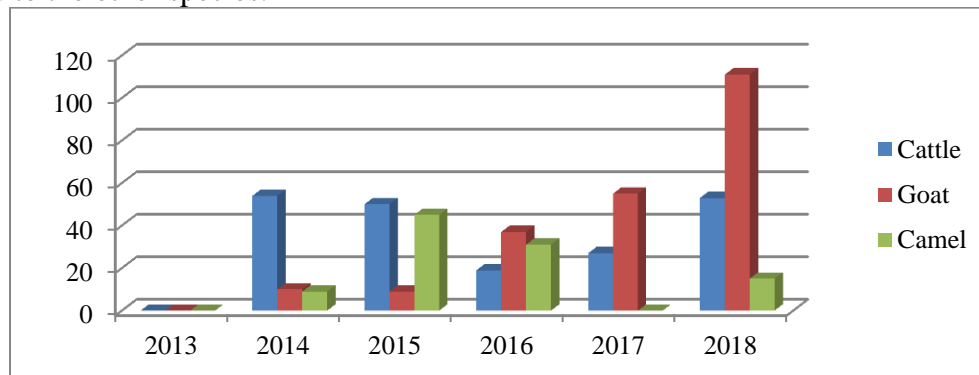


Figure 1: Comparison between Positive Cases of Brucellosis in Cattle, Goat and Camel, 2013-2018

Table (2) presents the mean values for the positive cases of brucellosis in cattle, goat and camel throughout the five years.

Compared to different years values' reported, the number of positive cases was significantly ($p < 0.05$) higher in cattle and

goats in 2016 and 2018 respectively and in camel in 2015. Compared to other species, cattle reported a significantly ($p < 0.05$) higher

prevalence in 2014 and 2015. During 2016, 2017 and 2018 goats had the significantly ($p < 0.05$) higher incidence of brucellosis.

Table2: Positive cases of brucellosis, 2014-.2018, (Mean± SD)

Year / Species	Cattle	Goat	Camel
2014	^A 4.5±13.44 ^a	^C 0.83±1.02 ^b	^C 0.75±1.71 ^c
2015	^B 4.17±6.06 ^a	^C 0.75±1.06 ^c	^A 3.75±0.08 ^b
2016	^C 1.58±1.68 ^c	^B 3.08±3.72 ^a	^B 2.58±3.44 ^b
2017	^B 2.25±2.18 ^b	^B 4.58±2.96 ^a	^C 0.58±0.99 ^c
2018	^A 4.41±5.74 ^b	^A 9.25±6.31 ^a	^C 1.25±1.71 ^c

Mean values within the same row bearing different superscripts (small) are significantly different.

Mean values within the same column bearing similar superscripts (Capital) are not significantly different.

The prevalence of brucellosis during different seasons in cattle is shown in Table (3). Compared to other years, values obtained were significantly higher ($p < 0.05$) in 2015 during winter and autumn in 2018, and significantly ($p < 0.01$) higher in 2014 during summer. Compared to other seasons, winter season had a significantly ($p < 0.05$) higher

values in 2015, 2016 and 2017. However, values obtained during 2018 winter was significantly ($p < 0.05$) lower compared to summer and autumn. Values obtained for summer season were significantly ($p < 0.01$) higher during 2014 values. The prevalence of brucellosis shows seasonal fluctuations.

Table3: Seasonal variation (Mean ±SD)in the prevalence of brucellosis in cattle

Year	Winter	Summer	Autumn
2014	^C 1.50±1.91 ^b	^A 12.0±23.33 ^a	^D 0.0 ^c
2015	^A 6.25±10.53 ^a	^B 1.5±1.29 ^c	^B 4.74±2.5 ^b
2016	^B 2.50±1.29 ^a	^B 1.5±2.38 ^b	^D 0.75±0.96 ^c
2017	^B 3.5±3.11 ^a	^C 0.75±0.96 ^c	^C 2.5±1.29 ^b
2018	^B 3.25±2.5 ^b	^B 5.00±4.97 ^a	^A 5.00±9.34 ^a

Mean values within the same row bearing different superscripts (small) are significantly different.

Mean values within the same column bearing similar superscripts (Capital) are not significantly different.

Table (4) shows the prevalence of brucellosis during different seasons in goats. Compared to other years, the values obtained in 2018 were significantly higher during winter and summer ($p < 0.05$) and autumn ($p < 0.01$). Compared to other seasons, the

values obtained during winter were significantly ($p < 0.05$) higher in 2014 and 2015 and during autumn in 2016. While it was significantly ($p < 0.05$) higher during summer in 2017 and 2018

Table4: Seasonal variation (Mean±SD)in the prevalence of brucellosis in goat

Year	Winter	Summer	Autumn
2014	^C 1.25±1.5 ^a	^D 0.75±0.96 ^b	^C 0.5±0.58 ^c
2015	^C 1.5±1.29 ^a	^D 0.75±0.96 ^b	^D 0.0 ^c
2016	^B 3.25±5.19 ^b	^C 2.5±3.69 ^c	^B 3.50±3.11 ^a
2017	^B 3.0±1.63 ^c	^B 6.75±3.5 ^a	^B 3.5±2.08 ^b
2018	^A 6.25±5.56 ^c	^A 12.25±7.09 ^a	^A 9.25±6.40 ^b

Mean values within the same row bearing different superscripts (small) are significantly different.

Mean values within the same column bearing similar superscripts (Capital) are not significantly different.

Table (5) shows the prevalence of brucellosis during different seasons in camels. Compared to other years, the values obtained were significantly ($p<0.05$) higher in 2016 during winter and during summer ($p<0.05$) and autumn($p<0.01$) in 2015. However, amongst seasons, compared to summer and autumn winter season showed a significantly

($p<0.05$) higher incidence in both 2014 and 2017. A significantly higher values in autumn of 2015 ($p<0.01$) and of 2018($p<0.05$) were reported compared to other seasons. However in 2016 the values were significantly ($p<0.05$) lower during summer compared to other seasons.

Table5: Seasonal variation (Mean \pm SD) in the prevalence of brucellosis in camel

Year	Winter	Summer	Autumn
2014	^B 1.75 \pm 2.87 ^a	^D 0.25 \pm 0.5 ^b	^D 0.25 \pm 0.5 ^b
2015	^C 0.75 \pm 1.5 ^c	^A 2.5 \pm 2.38 ^b	^A 8.0 \pm 16.0 ^a
2016	^A 3.0 \pm 1.82 ^a	^B 1.75 \pm 1.71 ^b	^B 3.0 \pm 6.0 ^a
2017	^B 1.00 \pm 1.15 ^a	^D 0.25 \pm 0.5 ^b	^D 0.25 \pm 0.5 ^b
2018	^B 1.25 \pm 1.5 ^b	^C 0.75 \pm 1.5 ^c	^C 1.75 \pm 2.36 ^a

Means in the similar row bearing different superscription are significantly different.

Means in the similar column bearing different superscription are significantly different.

Discussion

The current study was designed to investigate the prevalence of brucellosis in Bahri Locality during 2014-2018. Throughout the study period, cattle represented (38.6%) of the total positive cases recorded in the TVH and the majority were cross-bred(Holstein vs local breed). This is could be associated with the large number of dairy farms in Bahri locality with the majority kept under traditional breeding system with questionable hygiene measures. It could also be related to the increased movement of cattle amongst different Khartoum localities and states of Sudan. Generally, the lack of awareness for the importance of the routine testing for brucellosis or pre- purchasing testing played a great role in the spreading of the disease. Cattle owners only test for brucellosis when they are advised by veterinarians when there is a noticeable incidence of abortion. Compared to the previous findings, the current study reflected big values, as blood samples were examined for brucellosis in the TVH when cattle are introduced with other

health complains rather than abortions. In Khartoum State, Gameel *et al.*,(1987) reported 9 positive cases of bovine brucellosis out of 20 blood samples examined also 15.73% was reported by Fayza *et al.*, (1990). In Gezira state a prevalence rate of 1.2%, of bovine brucellosis was reported by Bakhiet (1981) in addition to 10.7% and 4.8% of in Nisheshiba and El Huda area by (Dafalla, 1962) and Mohammedahmed (2009) respectively. However, a prevalence of 20% (Musa *et al.*,1990) and 13.9% (Musa,1995) were reported in Darfur. Mustafa (2010) reported 10.3% in Nyala.

The main breeds of goats examined were Saneen, Nubian, Shami and crossbred. Compared to the other species examined the incidence of brucellosis was higher in goat(42.2%). This could be related to the high number of goats owned by people, whether they are reared in small (Domestic houses) or large (Farms) scales in Bahri locality.Also this could be associated with the advice of brucella testing before

purchasing of goats. Some herders before purchasing and introducing new flocks to their farms apply the pre-purchase testing policy in the TVH and positive ones are rejected and sent to the slaughterhouses. Moreover, goats introduced for natural mating with Saneen bucks in the TVH are routinely examined for brucellosis. Positive cases of caprine brucellosis were reported in different localities of Sudan but, they were of small values compared to the recent findings. Similarly, in Khartoum State, Mohamed *et al.*, (2018) reported a prevalence rate of 11.4% of brucellosis using RBRT. El Sawi *et al.*, (1981) reported 0.65% positive cases while five positive cases (25%) were reported out of twenty imported goats by Osman and Adlan, (1986). Fayza *et al.* (1990) reported only 0.1% positive cases out of 2233 goats examined for export. However, 190 tested goats were negative for brucellosis (Ginawi 1997). Moreover, out of 200 goats' blood samples 10.5% gave positive results (Nisreen, 2006).

Solafa *et al.* (2014) reported that the prevalence of brucellosis in 82 examined goats in Jabel Aolia locality was 18% ,while in Omdurman locality 16.57% were found to be positive (Azza, 2006). Mustafa (2010) reported 6% brucellosis in goats in Nyala. These findings indicate that caprine brucellosis became a common disease amongst local and foreign breeds in Bahri locality. Goat brucellosis is important as it affects human health causing Malata fever (Rossetti *et al.*, 2017)

The prevalence of brucellosis in camels was (19.04%); all samples were obtained from Albutana area located in Eastern Bahri locality. This finding indicates that camel brucellosis is a serious problem in Albutana area although all of them were examined for export purposes. This finding is associated with the mixed herding and the unrestricted

contact between cattle, small ruminants and camel that exposed them to diseases which were uncommon to their natural habitat as brucellosis (Musa and Shigidi, 2001). Camels are infected by lateral infection from the primary host of *Br. abortus* (cattle), and *Br. melitensis* (sheep and goats). Similarly, Musa (1995) reported 23% prevalence rate in area where camels were reared with cattle, 1.9% and 4.8% in herds newly introduced into such areas. Also this finding could be related to the fact that camels in the Sudan are not vaccinated against brucellosis (Mohammed and Abdelgadir, 2016). In Khartoum State Fayza *et al.*, (1990) reported 15.04%. In Darfur , Raga (2000) reported a prevalence of 6.2% and Musa and Shigidi (2001) reported 45.5% incidence of brucellosis in camels in Nyala Province caused by *Br. abortus*. In Eastern Sudan , Osman and Adlan, (1986) , Yagoub *et al.*, (1990) and Musa (1995) reported incidences of 8%, 6.95% and 7.75 % respectively . In Kassala State , Tag Elsir (2002) reported an incidence of 6% .

The high values obtained for brucella incidence in Bahri locality amongst different species could mainly be related to the absence of vaccination programme against brucellosis and to the common mixed herding. Husbandry system (Musa *et al.*, 2008) and mixed herding usually allows unrestricted contact between different species of animals and play great role in the spreading (cross transmission between species) of brucellosis (Renukaradhya *et al.* 2002). Generally, throughout the study period compared to camel, both cattle and goats showed higher incidences as they are widely reared.

Comparing between seasons, winter season (November, December, January and February) showed a general trend of brucella infection in cattle compared to summer and

autumn .This could be associated with autumn season (July, August, September and October) where rainfalls and pastures are rich and there is possible contacts and breeding between cattle where infection may happen and abortion occurs during winter. Dehkordi *et al.*,(2014) reported a higher rate of brucellosis in bulls semen in Iran. However, Alausa (1980) reported that there was no seasonal variation in the prevalence of brucella infection in cattle population studied in South Nigeria which indicates that climatic variation has no important role in the prevalence of brucellosis. As a contagious zoonotic disease of human and many species of animals, brucellosis showed seasonal variations in human as the majority of cases occurred during spring, summer and early autumn (AL-Ballaa, *et al.*, 1994).

Comparing between years of the study period there was fluctuations in brucellosis incidence. However, in 2018 the incidence was significantly higher during summer and autumn compared to winter and this could be related to owners' awareness for examination before purchasing.

In goat, brucella incidence showed fluctuations amongst different seasons. On the contrary, Abela (1999) reported seasonal variations of goat brucellosis which was associated with their parturition season. Compared to different years , 2018 showed a significantly higher incidence of brucellosis in the three seasons .This could be associated with the obligatory examination before introduction to breeding program in the TVH and to the awareness of examination before purchasing.

Between seasons, camel brucellosis showed a significantly higher incidence during winter and autumn (rain fall)(breeding season) (Yagil and Etzion, 1980). As winter season follows rain fall where pastures are rich and there is free herd movement and great chance

for exposure to infected ones. Boukary *et al.*(2013) indicated that the dynamics and frequent migration of pastoral herds might increase the chance of coming into contact and infection. However, amongst different years of the study period the incidence of brucellosis showed fluctuations. This could be associated with the number of blood samples presented for examination for export. Moreover, mixed herd might be the reason for this fluctuation.

The transmission of brucellosis to Bahri Locality population is possible through the consumption of unpasteurized milk, undercooked meat from those infected animals or by contact with their secretions. However, highly ranked at risk are veterinarians, butchers and milk handlers (Madut *et al.*, 2019).

Conclusions and Recommendation

It is concluded that, brucellosis is one of the serious diseases amongst different species in Bahri locality that can be reported throughout the year. Prevalence of brucellosis is associated with season of births and periods of animals contacts throughout the year.

Vaccination, testing and depopulation programs should be applied by the veterinary authorities. Herders have to avoid mixed herding as sharing grazing land and drinking water facilitate transmission of the disease. Animals' owners should be aware of the importance of brucellosis and its zoonotic and economical impacts. A joint work between Health and Veterinary authorities for epidemiological study amongst citizens of Bahri locality is needed.

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انتشار مرض البروسيلة في الابقار، الماعز والجمال (احادية السنم) في الفترة من 2014-2018 بمحلية بحري، الخرطوم، السودان

سهير سيد محمد عبدالرحمن

كلية الطب البيطري - جامعة بحري

المستخلص

هذه دراسة بأثر رجعي هدفت لاستقصاء معدل انتشار البروسيلة بين الحيوانات (الضأن، الماعز، الابقار، و الجمال) للحالات التي احضرت للمستشفى البيطري التعليمي - كلية الطب البيطري- جامعة بحري في الفترة من 2013-2018 . من جملة 5332 حيوان (ضأن،3586،73 ماعز،930 ابقار و743 جمال).تم اخذ عينة الدم من الوريد الوداجي لكل حيوان وفصل السيرم واختباره بكاشف الروز بنقال في المعمل الملحق بالمستشفى. لم تسجل حالة موجبة في الضأن وجملة الحالات الموجبة للبروسيلة كانت 525 (9.84%) وتشمل، 203 (38.67%) من الابقار، 222(42.29%) من الماعز و100(19.04%) من الجمال. مقارنة بالاعوام المختلفة فان عدد الحالات الموجبة للبروسيلة في الابقار كانت اقل معنويا ($p<0.05$) في العام 2016 واعلي معنويا($p<0.05$) في الماعز والجمال في الاعوام 2018 و2015 علي التوالي. بالمقارنة بين السلالات نجد ان العينات الموجبة للبروسيلة كانت اعلي معنويا ($p<0.05$) في الاعوام 2014 و2015 . في الماعز كانت العينات الموجبة للبروسيلة اعلي معنويا ($p<0.05$) في الاعوام 2016،2017 و2018.خلال فترة الدراسة عكست الاصابة بالبروسيلة تقلبات موسمية. في العام 2014 كانت الاصابة اعلي معنويا ($p<0.01$) في موسم الصيف بينما كانت اعلي معنويا ($p<0.05$) في الاعوام 2016،2015 و2017 في موسم الشتاء و اقل في شتاء 2018 مقارنة بموسمي الصيف والخريف.في الماعز كانت الاصابة عالية معنويا في موسمي الشتاء و الصيف($p<0.05$) والخريف ($p<0.01$) في العام 2018.في الجمال كان الاصابات في الاغلب عالية معنويا ($p<0.05$) في موسم الشتاء مقارنة بالمواسم الاخرى.تخلص هذه الدراسة الي ان الاصابة بمرض البروسيلة يشكل احد اكبر المشاكل الصحية في الابقار،الماعز والجمال بمحلية بحري وحدثه غالبا في موسم الشتاء.توصي الدراسة باجراء مسح شامل باستخدام تقنيات حديثة لمرض البروسيلة بالمحلية مصحوبا بنظام صارم ممول من الدولة للتطعيم، التخلص من الحيوانات المصابة ثم التعويض. ايضا هنالك حوجة لدراسات وبائية وسط المربين والمستهلكين.