EPIDEMIOLOGY OF BRUCELLOSIS IN SHEEP AND GOATS IN THE IRAQI KURDISTAN REGION

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Abstract:Brucellosis is an infectious zoonotic bacterial disease of worldwide importance. A cross-sectional serological study was undertaken in the Kurdistan Region to better understand the epidemiology of brucellosis in this region. A total of 694 sheep and 356 goats were sampled and tested with the Rose Bengal test. The seroprevalence in sheep (7.4%; 95% CI 5.5 - 9.6%) (OR 1.94; 95% CI 1.1 – 3.6) was significantly higher than that in goats (3.9%; 95% CI 2.2 - 6.5%). The highest seroprevalence among sheep (8.1%) was in Erbil province and the lowest in Dohuk province (4.9%). Among goats the highest seroprevalence (7.1%) was in Sulaymani province, and no seropositive goats were detected in Kirkuk and Dohuk provinces. The RBT seroprevalence in female sheep (6.5%; 95% CI 4.4 – 9.1%) was similar to that of males (9.3%; 95% CI 5.8 - 14.0%) (OR 0.67; 95% CI 0.38 – 1.21). The seroprevalence in female goats (4.7%; 95% CI 2.5 – 7.9%) was also similar to that of male goats (1.3%; 95% CI 0.0 – 6.9%) (OR 3.78; 95% CI 0.49 – 29.33).

Keywords: Epidemiology of Brucellosis, Sheep and Goats, Iraqi Kurdistan Region.

Introduction

Brucellosis is a zoonotic disease of livestock which is endemic in many countries of the world (Stites *et al*., 1987). The disease is caused by infection with bacteria belonging to the genus *Brucella* and has been recognized as a zoonotic disease since the discovery of *Brucella melitensis* in 1887 (Kaye and Petersdorf 1987). Transmission of *Brucella* occurs by contact with infected animals or their materials and disease in humans is always linked to disease in animals, predominantly livestock (Nicoletti, 1989). Brucellosis in animals results in significant economic losses because of abortions, reduced milk production, decreased reproduction rate and premature births (Pappas *et al*., 2006).

Although brucellosis has a worldwide geographical distribution, it particularly remains an important public health problem in the Mediterranean Region, North and East Africa, the Middle East, Southern and Central Asia, India, Central and South America (Faye *et al*., 2005). Infection of sheep with *B. melitensis* is endemic in the Mediterranean region, particularly along the eastern and northern shores. It is found through Central Asia, south to the Arabian Peninsula and as far as Mongolia and in India and Africa (European Commission, 2001). Although the main sources of infection are sheep, goats and their products, *B. melitensis* has emerged as an important problem in cattle in Saudi Arabia, Kuwait, some Southern European countries and Israel (First International Conferences on Emerging Zoonoses, 1997).

Materials and Methods

The Kurdistan Region is located in the north of Iraq and there are approximately 2.6 million sheep and 1.2 million goats in the Region (KRG, 2012), and these are mainly located in the villages, sub-districts and districts of the region. Field sampling was carried out from March 2015 to May 2015 throughout the Iraqi Kurdistan Region, and a two sampling plan was adopted. The first sampling plan was adopted in Sulaymani and Dohuk Provinces using a multi-stage sampling protocol. Six districts were randomly selected from Sulaymani Province and two from Dohuk Province for sampling. Within each selected district one sub-district was randomly selected. Two villages were then randomly selected from each selected sub-district and within each village five farmers were randomly selected from those available. Finally five animals (sheep and/or goats) were randomly selected from the selected farmers. Therefore in total 300 blood samples (216 sheep and 84 goats) were randomly collected (6 districts × 1 sub-district × 2 villages × 5 farmers × 5 animals = 300 samples) from Sulaymani Province and 100 blood samples (82 sheep and 18 goats) were randomly collected from Dohuk Province (2 districts × 1 sub-district × 2 villages ×

5 farmers × 5 animals = 100 samples). The number of sheep and goats sampled in the provinces was in proportion to the number of animals in that province. In Erbil and Kirkuk Provinces, blood samples were collected from sheep and goats by cooperating with the Veterinary Medical Centers (VMC) in these provinces. In Erbil Province there are 27 VMC, and 18 of these randomly collected 25 blood samples (sheep and goats) from each VMC (total 450 blood samples - 236 sheep and 214 goats). In Kirkuk Province 8 VMC collected 25 samples each for a total of 200 blood samples (160 sheep and 40 goats).

Overall a total of 694 blood samples were collected from sheep and 356 samples from goats in the four sampled provinces (Erbil, Sulaymani, Kirkuk and Dohuk). Five ml of blood was collected from the jugular vein directly into vacutainer tubes from each of the selected animals. Samples were then transported to the laboratories in the four provinces (Erbil, Sulaymani, Kirkuk and Dohuk) where they were centrifuged at 4000 rpm for 5 minutes and the sera separated and stored in Eppendorf Tubes prior to testing. All samples were tested within 24 hours of collection with the Rose Bengal Test (RBT) at room temperature as per the manufacturer's recommendations.

Using average values from the research of Blasco *et al*. (1994), EFSA-Q, (2006) and Rahman *et al*., (2013) the sensitivity and specificity of the RBT was estimated at 87.9 and 99.8%, respectively. These values were used to work out the real prevalence from the test prevalence.

Results

Of the 1050 animals sampled the overall seroprevalence was 6.2% (95% CI 4.8% - 7.8%). The seroprevalence in sheep based on the RBT (7.4%; 95% CI 5.5 - 9.6%) was significantly higher than that in goats (3.9%; 95% CI 2.2 - 6.5%) (OR 1.94; 95% CI 1.1 – 3.6). The overall real prevalence was estimated at (6.8%; 95% CI 4.8 – 7.8%) (Table 1).

Table 1: Seroprevalence to brucellosis based on the Rose Bengal Test in sheep and goats.

Species	Total number tested	Number positive on RBT	Seroprevalence (95% CI)	Real Prevalence (95% CI)	Odds ratio (95% CI)
Sheep	694	51	7.4% (5.5 - 9.6)	8.2% (6.3 – 10.5)	1.94 (1.1 – 3.6)
Goats	356	14	3.9% (2.2 - 6.5)	4.2% (2.4 – 6.8)	1.0
Total	1050	65	6.2% (4.8 - 7.8)	6.8% (4.8 – 7.8)	-

There was no significant difference in the seroprevalence in sheep between provinces based on the RBT. Similar observations were found for goats (Table 2). The seroprevalence was highest in sheep from Erbil (8.1%) and lowest in Dohuk (4.9%). In contrast for goats the seroprevalence was highest in Sulaymani (7.1%), and no seropositive goats were detected in both Kirkuk and Dohuk.

Table 2: Seroprevalence of brucellosis in sheep and goats originating from different provinces sampled in Kurdistan based on the RBT.

Species	Province	Total number of samples	Number RBT +ve	Prevalence (95% CI)	Odds ratio (95% CI)
Sheep	**Sulaymani**	216	17	7.9% (4.7 - 12.3)	0.98 (0.49 – 1.93)
	Kirkuk	160	11	6.9% (3.5 - 12.0)	0.84 (0.39 – 1.82)
	Dohuk	82	4	4.9% (1.4 - 12.1)	0.59 (0.19 – 1.78)
	Erbil	236	19	8.1% (5.0 - 12.3)	1.00

Goats	**Sulaymani**	84	6	7.1% (2.7 - 14.9)	1.98 (0.67 – 5.89)
	Kirkuk	40	0	0.00% (0.0 - 8.8)	-
	Dohuk	18	0	0.00% (0.0 - 18.5)	-
	Erbil	214	8	3.7% (1.6 - 7.2)	1.00

Table 3: Seroprevalence of brucellosis based on the RBT in male and female in sheep and goats.

Species	**Sex**	**Total**	**RBT +ve**	**Serorevalence (95% CI)**	**Odds ratio (95% CI)**
Sheep	**Female**	479	31	6.5% (4.4 – 9.1)	0.67 (0.38 – 1.21)
	Male	215	20	9.3% (5.8 – 14.0)	1.0
Goats	**Female**	278	13	4.7% (2.5 - 7.9)	3.78 (0.49 – 29.33)
	Male	78	1	1.3% (0.0 - 6.9)	1.0
Total	**Female**	757	44	5.8% (4.2 - 7.7)	0.8 (0.47 – 1.37)
	Male	293	21	7.2% (4.5 - 10.8)	1.0

The seroprevalence in female sheep (6.5%; 95% CI 4.4 – 9.1) was similar to that of males (9.3%; 95% CI 5.8 - 14.0%) (OR 0.67; 95% CI 0.38 – 1.21), also the seroprevalence in female goats (4.7%; 95% CI 2.5 – 7.9) was similar to that of male goats (1.3%; 95% CI 0.0 – 6.9) (OR 3.78; 95% CI 0.49 – 29.33) (Table 3).

Discussion

In this study overall 6.2% of animals were classified as seropositive. This was lower than that previously reported (14.5%) in Sulaymani (Jabary and Al-Samarraee, 2015) in unvaccinated herds and that reported by Al-Naqshabendy *et al.*, (2014) (39.1%) in non-vaccinated ewes in Dohuk. The differences in these two surveys may be the result of ongoing control programs through mass vaccination in the surveyed regions (Ministry of Agriculture and Water Resources, 2017). In the current study the seroprevalence in sheep (7.4%) was significantly higher than that in goats (3.9%). This difference is unexpected given the similar traditional husbandry practices of handling both species. Others have reported a higher seroprevalence in sheep than goats (Arslan *et al.*, 2011, Shareef, 2006) (23.6 and 10.6%, respectively).

Although recently other studies have been conducted on brucellosis in the same area as the current study, those studies included only a few districts and, similar to the current study, did report a significant difference in the seroprevalence between sheep and goats (Jabary and Al-Samarraee, 2015). In this study there was no significant difference in the animal-level seroprevalence between provinces. This was not surprising as the management and husbandry systems adopted are similar between provinces. Surprisingly no seropositive goats were found in Kirkuk and Dohuk Provinces. This could be due to the sample size, as the number of sheep and goats sampled in Erbil and Sulaymani provinces was larger than that for Kirkuk and Dohuk (overall the probability of detecting at least one seropositive goat was one positive to 25 goats sampled).

The seroprevalence in males and females (for both sheep and goats) was also similar in the current study. This finding was also expected because of the similar management practices males and females are subjected to. These findings concur with those previously obtained by Jabary and Al-Samarraee, (2015) who reported a prevalence of 14.3 and 15.1% in females and males, respectively and the study of Al-Hankawe and Rhaymah (2012) who reported a prevalence of 16.1 and 15.2% in females and males, respectively. Differences in seroprevalences between studies can arise from: the sample size; the tests used and the method of interpreting seropositivity ie in series or in parallel; the study location and the associated management and husbandry practices adopted within these locations; and the control methods, such as biosecurity measures and vaccination, adopted.

There are numerous reasons why brucellosis remains endemic in Iraq and Kurdistan Region. These include the uncontrolled movements of livestock flocks and herds particularly given the endemic status of brucellosis in surrounding countries, limited veterinary support services, the geopolitical situation, political instability, and husbandry practices which favor the spread of infection.

An efficient surveillance system is key to any successful control program, and should include regional and national surveillance, vaccination to increase the proportion of protective population, and strong collaboration between the veterinary and public health sectors. Critical to disease control is good management and husbandry practices, particularly associated with the introduction of animals, isolation/quarantine of animals which abort and the presence of wildlife which can act as reservoirs for the disease. Control or elimination of these factors will reduce the potential for disease transmission in an area. It is recommended that a vaccination program against brucellosis be implemented in Kurdistan and educational activities be implemented to improve awareness of the disease by livestock owners in the region.

Conclusions

Although brucellosis is close to being or has been eradicated from a number of developed countries, it continues to be a major animal and public health problem in many regions and countries of the world. From the results of this study it can be concluded that brucellosis is endemic in Iraqi Kurdistan Region and poses an important zoonotic risk to the human community.

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