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Serological study on query fever in sheep, goats and camels in Hail region, Saudi Arabia

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Abstract
This study was conducted in Hail region, KSA to find out the extent of Query fever (Q Fever) associated with unknown fever and abortion in sheep, goats and camels. 799 sera samples from female animals were collected as follows; 296 sheep, 300 goats and 203 camels. An indirect ELISA test was performed against Q fever antibodies. The results showed an overall seroprevalence rate of Q fever as 33.4% (267 of 799) distributed as follows; sheep 39.7%, goats 36% and camels 24.3%. There is high significant (*p* value = 0.000328) association of management; open to close system that found to be 61.1: 38.9; 73.7: 26.3; 90.6: 9.4 for sheep, goats and camels respectively. With regard to age of animals the results showed high significance (*p* value= 0.005) for animal species: (sheep goats, and camels) where the younger were highly susceptible to Q fever compared to older ones (73.4%: 63.3%). Indirect ELISA test showed no significance between sheep, goats and camels (*p* value= 0.670). The study concluded that Q fever is prevalent in farm animals in Hail region, Kingdom of Saudi Arabia.

Keywords: q fever, elisa, farm animals, Saudi Arabia, seroprevalence

Introduction

Q fever is a zoonotic disease which infects several animal species as well as human. This disease was first described in 1935 in Queensland, Australia during an outbreak of a febrile illness among abattoir workers (Derrick, 1973) [1]. The disease is caused by *Coxiella burnetti*, an organism that has been reported from almost all parts of the world (Anderson *et al*., 2013) [2]. It is considered as one of the main bacterial diseases causing severe losses to the livestock industry. Cattle, sheep and goats are the primary hosts; infected sheep and goats may abort in late pregnancy (Parker *et al.*, 2006) [3]. *C. brunetti* positive ticks might pose a risk for transmission to animals and humans through tick fecal excretions (Sprong. *et al*, 2012) [4]. Clinical signs of *C, burnetii* infection are abortion in sheep and goats and reproductive failure in cattle (Garcia-Pérez, 2009) [5]. The uterus and mammary glands are the primary sites of infection in the chronic phase of *C. burnetii* in ruminants. Shedding of this pathogen into the environment occurs mainly during parturition via birth products, but shedding through milk and feces has also been documented in sheep, cattle, and goats (Berri *et. al*., 2001; Guatteo *et. al*., 2006; and Rodolakis *et.al*, 2007) [6, 7, 8]. After lambing, ewes shed *C. burnetii* for a variable period of days, and several authors reported even longer bacterial excretion in fecal samples (Radokalis *et. al*., 2007) [8]. Infected animals shed the organism in urine, feces, milk, placental and birth fluids (Dorko. *et al*, 2008) [9]. Thus, the formation of aerosols contaminated with infected lambing products is the most common infection source for humans, although consumption of contaminated milk products has been linked with seroconversion (Fishbein and Raoult, 1992) [10]. In addition to inhalation of aerosols from infected ruminants such as cattle, sheep and goats, also human can be infected through exposure to animal products such as unpasteurized dairy products (García-Pérez, 2009) [5]. However, person-to-person transmission is rare but has been reported to occur through sexual contact and aerosol transmission (Whitney *et al*, 2009) [11]. In a study conducted by Jarelnabi in Saudi Arabia the disease was found to be endemic (Jarelnabi *et al*, 2018) [12]. Q fever has re-emerged as a public health and veterinary problem in many countries. A major epidemic of Q fever affecting nearly 4,000 people has been reported during 2007-2010 in the Netherlands, in which infected dairy goats were identified as the most likely source of infection (Schimmer, *et al*, 2009,Van den Borm and Vellema, 2009) [13, 14]. A multistate outbreak of human Q fever has also been reported in the USA (Maurin, and Raoult, 1999) [15]. Regarding the information of Q fever in animals in Saudi Arabia, two reports are found in the literature, one on serological detection of *C.*

burnetii in Saudi camels (Hussein *et al*, 2008) [17] and the other on sero-prevalence in some wild desert ungulates (Hussein *et al*, 2012) [16]. The earliest reference to Q fever in Saudi Arabia dates to the 1960's when the disease was first recognized as holo-endemic among the inhabitants of the country (Schimmer, *et al.*, 2009 and lippi *et al*, 1968) [13, 18]. Over the next 50 years, three reports on human Q fever and two on animals have been published. In humans, a single case of acute Q fever leading to meningoencephalitis was reported in a US soldier returning from Saudi Arabia after the first Gulf war (Yoshiie, *et al*, 1991) [19]. It is also found that 18 out of 51 persons in Saudi Arabia tested by immunofluorescence were positive to Q fever antibodies, but no information was available on their history or location (Almogren, *et al*, 2013) [20]. Goats are important sources of *C. burnetti* infection in people, seven serotypes were conducted on goats in Iran between 2005 and 2016. According to the results of this meta-analysis, the seroprevalence of Q fever in goats was 31.97%. Also, 93.42% of the goat's herds were seropositive in Iran. In similar studies, goats seropositivity were 13% to 23% in Africa (Vanderburg *et. al*., 2014) [21], 20% to 46% in Kenya (Nejru *et. al.*, 2016) [22] and 0.8 to 60.6% in China (El-Mahallaw *et. al.* 2013) [23]. The present study was therefore, undertaken to investigate the sero-prevalence of *C. burnetii* in different species of farm animals in Saudi Arabia. No information on the prevalence of Q fever in other agro-economically important animal species in Saudi Arabia is presented in details. This is considered important since farm animals infected with *C. burnetii* sometimes experience reproductive disorders, besides being the main source of human infection (Anderson, *et al*, 2013) [2].Main objectives of this study to determine the prevalence of Q fever among sheep, goats and camels and to study the risk factors associated with Q fever (species, age and management system) in Hail region, KSA.

Materials and Methods

This study was conducted in Hail region, KSA. A cross-sectional survey was performed on animals partly kept in pens (close management) in addition to those on grazing lands (open management). A total of 799 sera samples from three animal species (sheep, goats and camels) were collected all over the experiment period as follows: (296 sheep; 300 goats and 203 camels). The animals were selected on the basis of unknown fever that cause either abortion or stillbirth. The age and breed of female animals were as follows; younger animals 1-2 years (unipara) and elder animals 2 to 5 years (multipara), breeds studied were: "Najdi, Neaimi and Harri" breeds, for sheep and "Aardi and Demasqi" breeds for goats. As for camels, they were divided into younger animals 5-6 years (unipara) and elder animals 6 to 15 years (multipara) from "Maghateer, Majaheem" and mixed breeds. The collected sera samples were screened for *C. burnetii* antibodies at Dept. of Physiology, laboratory, University of Hail. An indirect ELISA (IDEXX CHEKIT Q fever Antibody ELISA Test Kit, IDEXX Laboratories, Switzerland) was used and the results were evaluated according to the manufacturers' recommendations.

Results

The distribution of the number of samples from different animals species investigated during this study were listed in table (1) where the samples taken were 296, 300 and 203 for sheep, goats and camels respectively. Frequencies of management, open to close system were shown in table (2). While the frequencies of age animals were shown in table (3).

The results of collected sera samples of the 799 animals shown an overall seroprevalence rate of the disease to be 33.4 % (267 out of 799) distributed as follows; 39.7%, 36% and 24.3% for sheep, goats and camels respectively. (Table 4).

Table 1: Distribution of number of samples among camels, sheep and goats

S. No.	Type of Animal	Frequency	Percent
1	Camel	203	25.4
2	Goat	300	37.5
3	Sheep	296	37
4	Total	799	100

Table 2: The management system (close to open) during the study.

S. No.	Management Type	Frequency	Percent
1	Close	586	73.3
2	Open	213	26.7
3	Total	799	100

Table 3: Frequencies of age of animals.

S. No.	Age	Frequency	Percent
1	Old	540	67.6
2	Young	259	32.4
3	Total	799	100

Table 4: The results of ELISA for different animals species camel, sheep and goats.

Animals	ELISA Positive	ELISA Negative	Percent of Positive
Camels	65	138	24.3
Goats	106	194	36
Sheep	96	200	39.7
Total Number	267	532	799
Total Percent	33.4	66.6	100

With regard to management system results showed high significant association of management (*p* value = 0.000328); open to close system where it was found to be 61.1:38.9; 73.7:26.3; 90.6:9.4for, sheep, goats and camels respectively Figure (1).

Concerning the age of animal the results showed high significance (*p* value= 0.005) for different animal species (sheep, goats and camels) where the younger were highly susceptible to Q fever compared to elder ones (73.4%:63.3%). Figure (2).

The results of ELISA for detection of Q fever showed no significance between different animal species (*p* value= 0.670) as shown in Figure 3.

Regarding the management and species factor, the animal of study categorized in (open-close) systems; sheep in close and open system (n=181, 61.1% in close) and (n=115, 38.9% in open) while for goats it was found to be (n= 221, 73.7% in close) and (n=79, 26.3% in open) in addition to camels where the result was found to be (n=184, 90.6% in close) and (n=19, 9.4% in open). The infected animals in close system were (n=217, 81.3% of 532), while the infected animals in open system were (n= 50, 18.7% of 267), Figure (4), highly significant association was observed between close management and Q fever (*p* value, 0.000000000023).

The factor of age was also studied where 259 (32.4%) of animals were young and 540 (67.6%) were old ones (Table, 3). It was found that 198 (36.7%) of old animals were infected, while 69 (26.6%) of young animals were infected. There was a significant association observed between age and Q fever infection, where the infection was more prevalent in younger ones.

Regarding the association of ELISA results between sheep, goats and camels the results showed no significant difference between the species (Fig. 3), (*p* value 0.670).

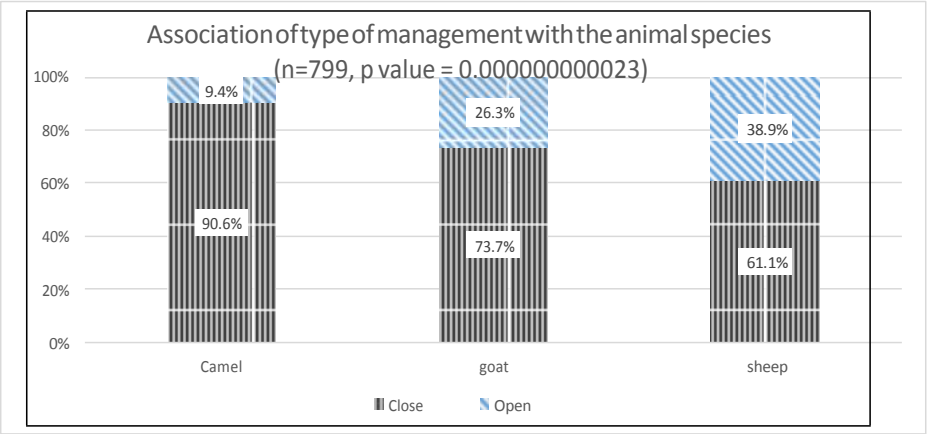

Fig 1: Association of type of management with the prevalence of Q fever among camels, sheep and goats

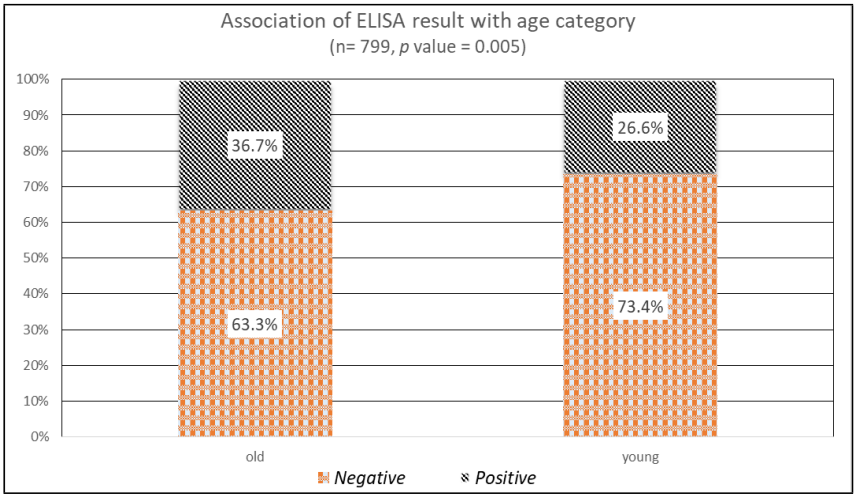

Fig 2: Association of Q fever with the age of camels, sheep & goats

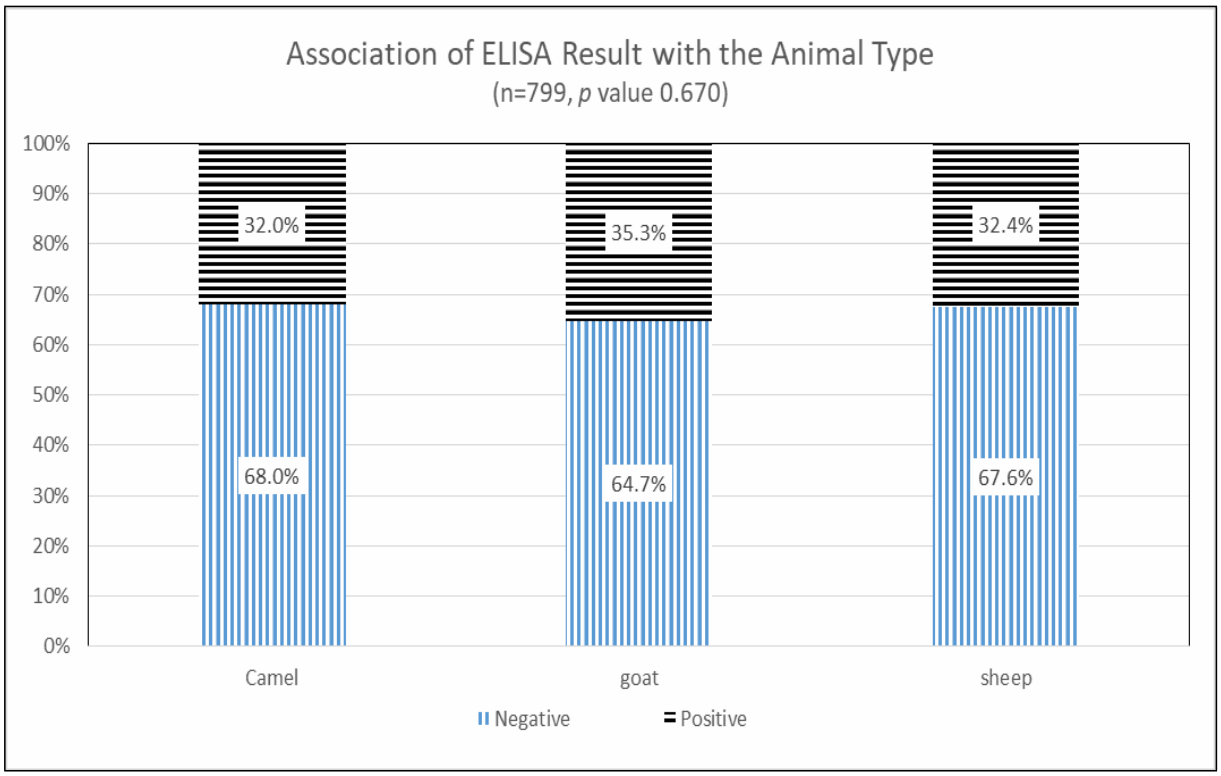

Fig 3: Association between Q fever with the Animal Type (n=799, p value 0.670)

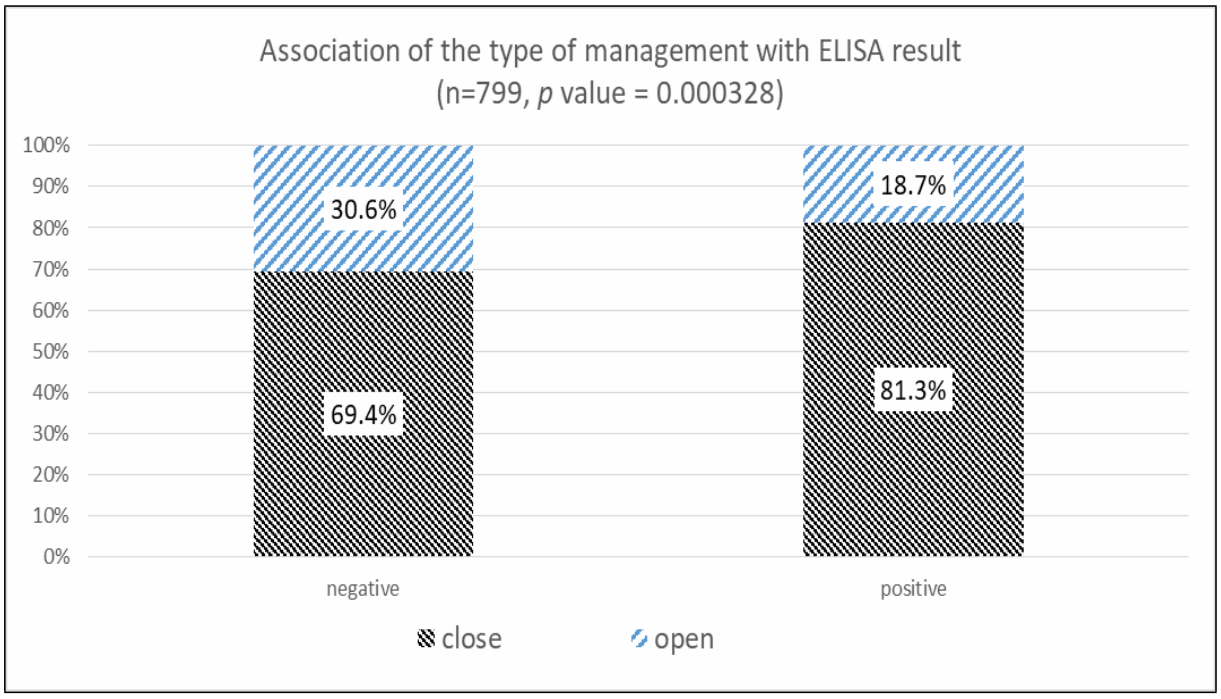

Fig 4: Association of the type of management with Q fever

Discussion

The current study conducted among sheep, goats and camels in Hail region, KSA using indirect ELISA CHEKIT Q fever test to screen antibodies to *C. burnetii*. The results showed the presence of antibodies against Q fever. The serological diagnosis of Q fever is considered a reliable diagnosis, in particular, the indirect ELISA (*Anderson, et al.*, 2013) [2]. The results of this study demonstrated that *C. burnetii* has been circulating in livestock populations in Hail region. The seroprevalence of *C. burnetii* antibodies was found to be 39.7%, 36% and 24.3% for sheep, goats and camels respectively. These results were in accordance with a study performed in KSA representing a seroprevalence of 51.53%, 34.04% and 12.38% in camels, goats and sheep respectively. The results indicated that Q fever is common in all species of indigenous farm animals, with an apparent overall seroprevalence exceeding 30%. The prevalence in goats was 36% which is lower than reported in Iran (93.42%). In Kenya (Vanderburg *et al*., 2014) [21]. reported the Q fever as 13% to 23% while in China it was found to be

0.8% to 60.6% (El-Mahallaw *et al*., 2013) [23]. In northwestern Iran the seroprevalence among sheep was 29.4% (Sakhaee and Khalili, 2010) [24] compared to ours which is 39.7%, where the seropositivity among goats was 65.8% (Khalili and Sakhaee 2009) [25], ours is 36%. Literature review on the prevalence of *C. burnetii* infection in domestic ruminants in different countries worldwide, revealed a wide variation in reported prevalence (Guatteo *et al*., 2011) [26].

The species of the animal is a factor affecting seropositivity in this study, sheep (39.7%), goats (36%) and camels (24.3%). The lower prevalence rate for camels could be to fact that: camels are in continuous movement over large stretches of land and this reduces contact between sick and healthy animals as opposed to goats which were always grazed around the homesteads thus increasing the chances of contracting the disease.

The age of the animals in the study was found to be a significant risk factor for seropositivity. The younger the animals were, the higher the chances of animal being seropositive. There is an observation among age groups indicated that replacements ewes (6 months to 1 year old) were not exposed to the bacteria until the lambing season, when increased excretion of the agent causes greater exposure rates (Maurin and Raoult, 1999) [15].

A high significant association was observed between close and open management systems and the Q fever (*p* value= 0.000328) where open to close system was found to be 61.1: 38.9; 73.7: 26.3; 90.6: 9.4 for sheep, goats and camels respectively. Infection by C. burnetii in sheep, goats and camels flocks in this study can be widely spread and might represent a risk for the human population. Housing animals within a close area poses a factor to inhale infected aerosols which is a major mode of transmission (Bosnjak et. al., 2010) [27]. of Q fever from animals to humans.

Conclusion

Q fever infection is found in farm animals in Hail region, KSA, more prevalent in sheep and goats but less in camels. The stud Recommended that investigate the Q fever in farm animals "& pets" and humans (shepherds & breeders). The veterinarians should verify all abortion cases "with especial reference to Q fever". I MOH at KSA should put Q fever into consideration and do a project cooperating with the animal health sector in MEWA to do a sero-surveillance for the disease. The physicians and health care workers should be informed about Q fever bacteria circulating in KSA. Implementation of Q fever control strategies and highlights the potential risk of sheep & goats as a reservoir and infection source for other domestic and wildlife species and the human population.

Conflict of interest

NO have a conflict in this work.

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