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Risk factors associated with contagious caprine pleuro-pneumonia in goats in pastoral areas in the Rift Valley region of Kenya

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ABSTRACT

A cross-sectional study to determine risk factors associated with sero-prevalence of contagious caprine pleuro-pneumonia (CCPP) in goats was carried out between the months of March, 2014 and March, 2015 in Pokot East, Turkana West and Kajiado Central Sub-counties. A semi-structured questionnaire focusing on risk factors for CCPP was completed for each flock whose serum samples were collected. A logistic regression model was developed to assess the association between the risk factors and CCPP sero-positivity. Of the 54 flocks, 49 (90.7%) presented at least one sero-positive animal. Two hundred and four of the 432 goats tested sero-positive at monoclonal antibody based competitive Enzyme-linked immuno-sorbent assay (c-ELISA), hence a sero-prevalence of 47.2% (95% CI = 42.5– 51.9). Previous exposure of flocks to CCPP ($p < 0.001$, OR = 52.8; CI = 6.45, 432), distant sources of veterinary drugs ($p < 0.001$, OR = 6.17; CI = 3.41, 11.1), movement of goats to dry season feeding areas ($p < 0.001$, OR = 4.31; CI = 2.39, 7.75) and markets as a source of new introductions to the flock ($p = 0.033$, OR = 1.86; CI = 1.05, 3.27) were identified as risk factors significantly associated with CCPP sero-prevalence. The findings provide further evidence supporting the high prevalence and endemic state of the disease in pastoral flocks and hence there is need for adequate measures to be put in place to control the disease effectively.

1. Introduction

Contagious caprine pleuro-pneumonia (CCPP) is a highly contagious and often fatal disease of goats caused by *Mycoplasma capricolum* sub. spp. *capripneumonia* (mccp). CCPP is characterized by cough, severe respiratory distress, pyrexia (40.5–41.5 °C), nasal discharge, which is catarrhal at the beginning and becomes muco-purulent in the later stage of disease. In chronic cases, the nasal discharges become thick and pasted on the nostrils. At this stage, animals show sporadic coughing, emaciation, and diarrhoea (Radostitis et al., 2006). Cases of CCPP result in variable but often high morbidity and mortality rates in susceptible flocks of all ages and in both sexes, and abortions in pregnant goats is common (OIE, 2014). The disease is a major constraint to the goat industry in developing countries and is endemic in Africa, the Middle East and Asia (Manso-Silván et al., 2007; Nicholas and Churchward, 2012). Since the disease occurs in epidemics, antibiotic treatment, as the only control measure would be very un-economical. Vaccination associated with antibiotic treatment is the most effective strategy and antibiotics such as the tetracyclines, fluoroquinolones and the macrolide family are generally effective clinically if used early enough (Ozdemir et al., 2005).

A precise description of the distribution of CCPP is not available mainly due to a lack of highly sensitive and specific diagnostic tests and difficulty of identification of the organism causing the disease (Nicholas, 2002). What is certain is that the disease is present in Africa and the Middle East where it has been reported in 30 countries in these continents (Thiaucourt and Bolske, 1996) and represents a significant threat to many disease-free areas as demonstrated by isolation (the confirmatory test required by the OIE) and molecular characterization of Mccp isolates (Woubit et al.,

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2004). The disease is included in the list of notifiable diseases by World Organization of Animal Health (OIE) because of its very high morbidity and mortality rates causing significant socio-economic impact once introduced into a country. A specific risk for the disease is that it has been spreading beyond its traditional distribution area with effects on livelihoods and international trade (AU-IBAR, 2015).

According to Pan African Animal Health Yearbook, seven countries reported the occurrence of CCPP in 2011, with Ethiopia, Somalia and Tanzania consistently reporting the disease since 2008 to then (AU-IBAR, 2014). The disease seems to be confined to the eastern and central Africa regions based on the reports received. CCPP is transmitted by direct contact through inhalation of infective aerosols from infected goats by susceptible goats. The disease is highly contagious and only brief periods of contact are necessary for successful transmission (Thiaucourt and Bolske, 1996). Disease outbreaks often occur after heavy rains and after cold spells probably because recovered carrier animals start shedding the mycoplasmas after the stress of sudden climatic change. It is these latent carriers that have been reported responsible for the perpetuation of the disease in a flock (Thiaucourt and Bolske, 1996; Wesonga et al., 1998).

Several studies on CCPP outbreak investigations and isolation of the causative agent have been conducted. However, information on sero-prevalence and associated risk factors is scanty. The current study was conducted in Turkana, Baringo and Kajiado Counties of Rift valley region of Kenya to estimate the risk factors associated with prevalence of the disease in pastoral areas and provide information useful for making informed decisions in developing and recommending targeted control measures for effective control.

2. Materials and methods

2.1. Selection of study sites

The sites were purposely selected to represent different epidemiologic states of the disease; border counties where there is high animal contact across the borders which is a risk factor and a county which does not share international boundary. The study areas were stratified into livestock grazing regions based on the direction of livestock movement (migratory routes) to the three neighbouring countries that include Oldonyo-Orok group ranch and Torosei in Kajiado Central Sub-county with migratory routes between Kenya and Tanzania; Oropoi and Loremet grazing areas in Turkana West Sub-county with migratory routes between Kenya and Uganda as well as South Sudan. These grazing areas were selected to represent sites that share international boundaries where animals occasionally mix with those in adjoining areas of the neighbouring countries in dry season grazing, watering points and markets. Silale and Orus grazing areas in Pokot East Sub-county were selected to represent areas far from international boundaries.

2.2. Study design and sampling

A cross-sectional study was carried out between March 2014 and March 2015 using multistage random sampling method. A list of all locations and their sub-locations were obtained through the assistance of the local administration. From the list, one location per ward and one sub-location in each location were randomly selected using random number tables. A list of all *adakaars*/villages were obtained in each sub location selected. Three villages and three livestock owners from each of the villages whose flocks had no history of vaccination for at least a year prior to the commencement of the survey were randomly selected to participate in the completion of the structured questionnaires. Finally, systematic random sampling was applied to select goats from each flock to be bled for serum sample collection. A total of 18 Adakaars/villages were used for the study.

2.3. Questionnaire data collection

A pre-tested semi-structured questionnaire focusing on risk factors for contagious caprine pleuropneumonia was administered to the participating pastoralists in an interactive manner through personal interviews to obtain in-depth information on pastoralists' knowledge, attitudes and practices that could be potential risks factors associated with outbreaks of the disease. Piloting of the questionnaire was conducted in sites where the study was to be done and three pastoralists from each of the study areas were requested to respond to the questionnaire. The aim was to assess the timing of interview, the respondents' reactions to the question format, wordings and order of asking questions and ensure that the final questionnaire to be used was understandable. The results of the questionnaires were reviewed and revisions were made accordingly considering the significant problems detected during pre-testing. The questionnaire was designed to record the respondents' location, household characteristics and livestock management practices. A number of open-ended questions were included in the questionnaire to allow the pastoralists an opportunity to provide their perspectives and experiences on treatments and methods available for CCPP control.

2.4. Collection of blood samples and serology

The number of goats bled for serology were determined using the formula for sample size estimation; $n = Z^2 \alpha pq/L^2$, (Martin et al., 1987).

Where, n = sample size, Zα = normal deviate (1.96) at 5% level of significance, p = estimated prevalence, q = 1-p and L = precision of estimate usually at 5%. A priori prevalence of 30% was used based on the findings by Wafula, (2006) in a study done in Turkana. From the formula, the sample size was calculated as follows;

$$n = 1.962 \times 0.3(1 - 0.3)/0.052$$

$$n = 3.8416 \times 0.21/.0025 = 322.72–323.$$

To adjust for potential non-compliance and design effect, the calculated sample size was increased by 30% bringing the totals to 419.9 ~ 420. Further, from the calculated sample size, 7.78 goats were to be selected for biological sample collection from each pastoralist which was rounded off to 8 hence the final sample size was put at 432 goats to be selected from 54 flocks. Blood samples were collected from the jugular vein in clean sterile vacutainers and allowed to clot. Sera were separated and kept frozen at −20 °C until used for serology.

Monoclonal antibody based competitive Enzyme-linked immuno-sorbent assay (c-ELISA) was used to assess presence of specific antibodies against *Mycoplasma capricolum* sub. spp. *capripneumonia* (mccp) using the procedure described by Peyraud et al., 2014. The test kit was supplied by CIRAD-EMVT, France. The test has been evaluated and it has a strict specificity of 99.9%. It allows the detection of positive sera in CCPP-infected herds, but its sensitivity at the individual level has not yet been fully evaluated and thus true prevalence of the disease cannot be computed (OIE, 2014). The test sera were examined in 96-well flat bottom microplates coated with Mycoplasma F38 antigen diluted with 0.01 mol/L phosphate-buffered saline, pH 7.2–7.4. There were control sera of strong positive serum, weak positive serum, a test laboratory positive serum and monoclonal antibody (Mab) per plate. The plate was incubated at 37 °C for 1 h, washed with