Parasitological Survey on Tick-borne Piroplasms of Small Ruminants in Eastern Saudi Arabia

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ABSTRACT

Piroplasmosis is a serious disease affecting small ruminants around the globe. Determination of its prevalence in a respective area is a key factor in development of effective control measures. The prevalence of this disease amongst small ruminants in The Eastern Province of Saudi Arabia was, investigated during the period from January to December 2010 in the present study. Giemsa-stained thin blood smears and impression smears prepared monthly from sheep and goats in Al-Dammam, Al-Qatif and Al-Jubail were, examined for the presence of tick-borne piroplasms. A total number of 3211 small ruminants (1698 goats, 1513 sheep) were examined for both *Babesia* and *Theileria* parasites. The overall prevalence of *Babesia* infection was (36.56%±4.03) while that of *Theileria* was (0.06%). Four species of piroplasms were detected in the study area namely *Babesia ovis*, *B. motasi*, *Theileria ovis* and *T. lestoquardi*. A percentage of 36.04%±4.23 of the examined goats and 37.27%±5.95 of the examined sheep were infected with *Babesia*. The highest seasonal prevalence of *Babesia* infection was reported in spring (45.19±4.05) and summer (41.43±6.62), followed by winter (34.02±10.21) and autumn (25.59±8.97). Ticks identified in this study include *Rhipicephalus* and *Hyalomma*. Ardi and Janobi breeds of goats are most susceptible, followed by crossbreed and Shami breed. In sheep, Neimi breed is the most susceptible followed by Arabi and crossbreed. Animals over one year of age are more susceptible to infection than those aging less than one year. No significant difference reported in susceptibility to infection between different sexes of both animal species.

Key Words: *Babesia*, Hemoparasites, Impression smear, Prevalence, Province, *Theileria*.

INTRODUCTION

Sheep and goats are considered the main animal resources in Saudi Arabia and their production constitutes a major part in the Saudi agricultural sector (El-Metenawy, 1999; El-Azazy *et al.*, 2001). Their number according to the estimation of the Saudi Ministry of Agriculture is 8,500,941 sheep and 2,478,501 goats. In spite of the efforts towards increasing local production of sheep and goats in Saudi Arabia, a large number of these animals are still annually imported to meet the daily consumption demands and to cover the requirements of Al-Hajj (pilgrimage) event. Therefore, it is imperative to encourage the efforts towards increasing domestic production of sheep and goats to meet the local demand of the country. Flock health, effective disease control practices, and services play major role in the development of small ruminant production (Marshall *et al.*, 2017). Tick-borne hemoprotozoan diseases represent a major obstacle in the production and health of livestock. Theileriosis and babesiosis are disease entities reflecting infection with *Theileria* and *Babesia* respectively. Their effects on susceptible hosts vary from reduced productivity to death (Yitayew and Samuel, 2015). These diseases are transmitted by ticks (Zahid *et al.*, 2005). Ticks affect the production of over one billion cattle and a similar number of sheep around the world (Estrada-Peña, 2001). The annual loss inflicted by tick-borne hemoprotozoan diseases around the globe may reach several billion USD (Yin and Luo 2007). Over the past 100 years, ticks and tick-borne diseases play a major role in underdevelopment of livestock especially in the developing countries (Peter *et al.*, 2005). Therefore, control of these diseases will greatly improve livestock production (Domingos *et al.*, 2013). Determination

of distribution and incidence of tick-borne hemoprotozoan parasites in a given location is the first step for setting effective control measures. In Saudi Arabia, few information are available on tick-borne hemoprotozoan diseases (El-Azazy *et al.*, 2001), particularly the prevalence of theileriosis and babesiosis in small ruminants. Previously, *Theileria ovis*, *T. lestoquardi*, *Babesia ovis* and *B. motasi* have been recorded in Saudi Arabia (Hussein *et al*., 1991; Al-Khalifa *et al*., 2009). However, published epidemiological studies about the prevalence, seasonality and potential tick vectors of these parasites in the Eastern Province of the country are scarce. The present study is designed to investigate and determine the prevalence of tick-borne hemoparasites infecting sheep and goats in the Eastern Province of Saudi Arabia. Also to investigate the effect of animal sex and age on susceptibility to infection together with identifying and determining the possible tick species involved in the transmission of these parasites to sheep and goats flocks.

MATERIALS AND METHODS

Study Area

The present study was conducted in Eastern Province of Saudi Arabia, that is located between latitudes 25^{o} and 30^{o} north, and longitudes 43^{o} and 51^{o} east. Three localities in this Province, namely, Al-Dammam, Al-Qatif and Al-Jubail were chosen for this survey. The Eastern Province is 5-160 m above sea level and is hot and humid in summer, cold with some rainfall in winter. The mean temperature ranges from 28.5-44.2°C in summer and 10.4-22.7 °C in winter. The relative humidity is about 36-79% (National Meteorology & Environment Center).

Blood and Lymph Node Samples

A total of 3211 blood samples were collected directly from the ear vein of 1698 goats and 1513 sheep of randomly selected flocks in and around Al-Dammam, Al-Qatif and Al-Jubail. Blood samples were also collected from animals that were brought to Dammam Veterinary Clinic for routine examination and from animals that were slaughtered for human consumption at Al-Dammam Central Slaughterhouse. Thin blood films were prepared, air dried, fixed with methyl alcohol and transferred to the laboratory for examination. A number of 575 lymph node impression smears (320 of sheep and 255 of goats) were also prepared from samples collected from suspected animals suffered from enlarged superficial lymph nodes that were admitted to the Veterinary Clinic, as well as from animals in the slaughterhouse for detection of schizonts (Koch's blue bodies) in suspected theileriosis infections. Blood and lymph node smears were stained with freshly prepared diluted Giemsa to 10% in phosphate buffer, pH 7.2, as described by Bock *et al.* (2006). The slides were examined microscopically under oil immersion with a 100X objective using a Nikon light microscope. Fifty microscopic fields were examined per slide. Identification of *Babesia spp*. and *Theileria spp*. was carried out based on Soulsby (1986) and Urquhart *et al*. (2006).

Collection and Identification of Ticks

The sampled animals were inspected for the presence of tick infestation through observation as well as palpation, mainly on the ears, along the neck, perineum, under the tail and udder area. The ticks were removed manually, stored in 70% alcohol, labeled with collection points and animal species, and then taken to the laboratory. Ticks were morphologically examined under a stereomicroscope and identified according to Walker *et al.* (2003).

Statistical Analysis

A SAS statistical package used to compare infection rates among different animal species, breeds, age groups, sexes and between seasons. P value <0.05 was considered statistically significant.

RESULTS

Piroplasms Infection

Clinical Signs

Clinically, all affected animals of both species showed varying degrees of different signs graduated from mild fever, decrease of appetite and anemia to severe signs including high fever, anorexia, severe anemia, increased respiratory rate, muscular tremors, jaundice, edema, coughing, nasal discharge, diarrhea, dyspnea and recumbency. Some cases with severe clinical signs ended to death. Some infected animals were apparently healthy, whereas, others showed only anemia and ill thrift. Hemoglobinurea was only observed in three infected animals. All the above clinical signs suggest *Babesia* infection. However, an Arabi breed ewe which was admitted to the Veterinary Clinic in Al-Qatif showed recumbency, heavy tick infestation, high fever (40^{o}C), emaciation and pale mucous membranes, enlargement of superficial lymph nodes, respiratory distress and diarrhea and eventually died suggesting malignant theileriosis.

Microscopic Examination

Blood Smears

Examination of thin blood smears of the 3211 animals revealed the presence of intra-erythrocytic piroplasms in 36.68% (representing 1178 animals). The tick-borne hemoparasites identified based on morphology of the intra-erythrocytic forms visible in stained blood films. Most of the detected piroplasms were polymorphous, including single and paired pyriform, single ring, double ring, rod-shaped, irregularly shaped or budding forms (Fig. 1). The piroplasms were of different sizes (small and large forms) and the angles between two pyriform piroplasms were mostly acute (Fig.2), whereas other forms were obtuse (Fig.3). These piroplasms were identified as *Babesia motasi* and *B. ovis* respectively. On the other hand, only 0.13% (equivalent to 0.06% of small ruminants) of the surveyed sheep showed small piroplasms in their red blood cells. Animal with high parasitemia harbor piroplasms of round, oval, rod-shaped, or comma-shaped forms found in single, pairs or quadrant forms (Fig.4). While animal with low parasitemia showed anaplasma-like parasite (Fig.5). Both types of piroplasms were identified as *Theileria lestoquardi* and *T. ovis* respectively. These piroplasms were absent from the surveyed goats.

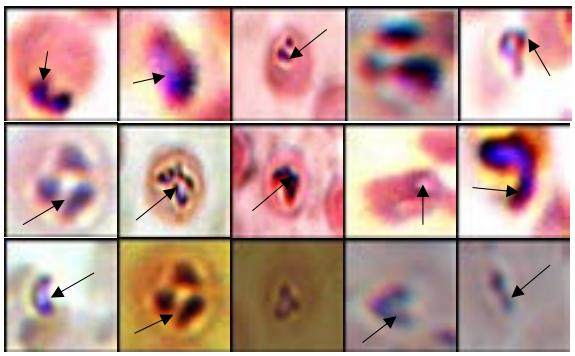

Fig.1. Light micrograph of Giemsa-stained thin film of sheep blood showing different forms of Babesia (Arrows, magnification X 1000). Scale: 1cm ≡ 2µm.

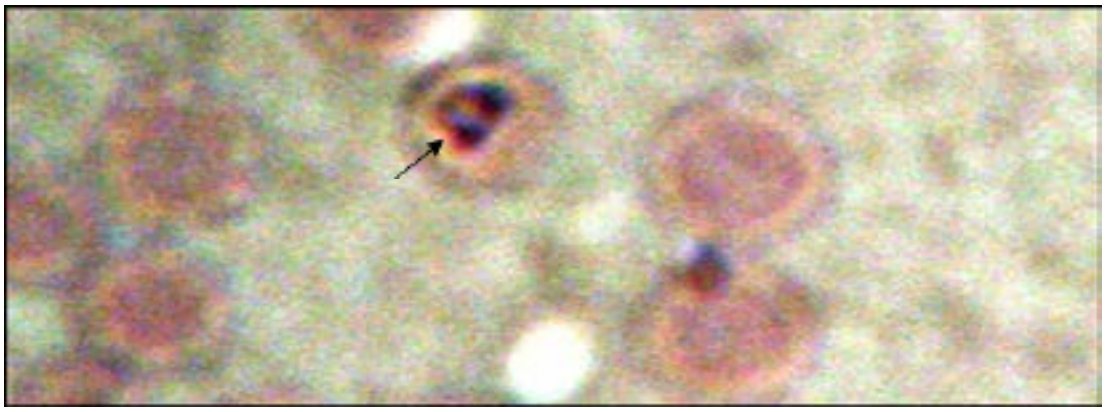

Fig. 2. Light micrograph of sheep blood smear showing *Babesia motasi* of double piriform piroplasm with acute angle (Arrow, magnification X 1000). Scale: 1cm ≡ 2µm.

Fig. 3. Light micrograph of sheep blood smear showing *Babesia ovis* of double ring form with obtuse angle located in the margin (Arrow, magnification X 1000). Scale: 1cm ≡ 2µm

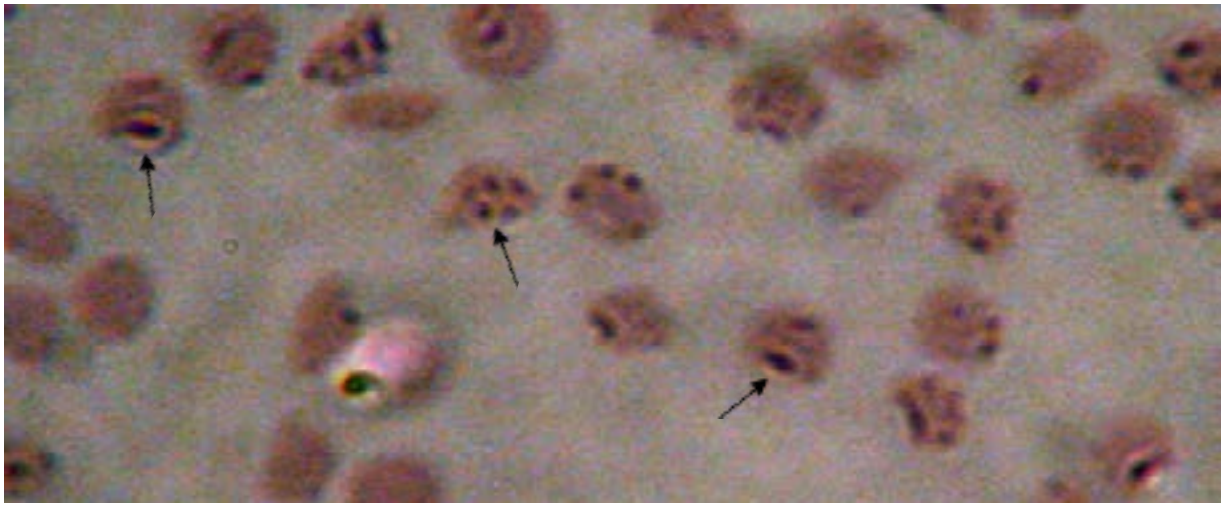

Fig. 4. Light micrograph of sheep blood smear with high parasitemia of *Theileria lestoquardi* (round, oval, comma and rod-shaped forms) (Arrows, magnification X 1000).
Scale: 1cm ≡ 6µm.

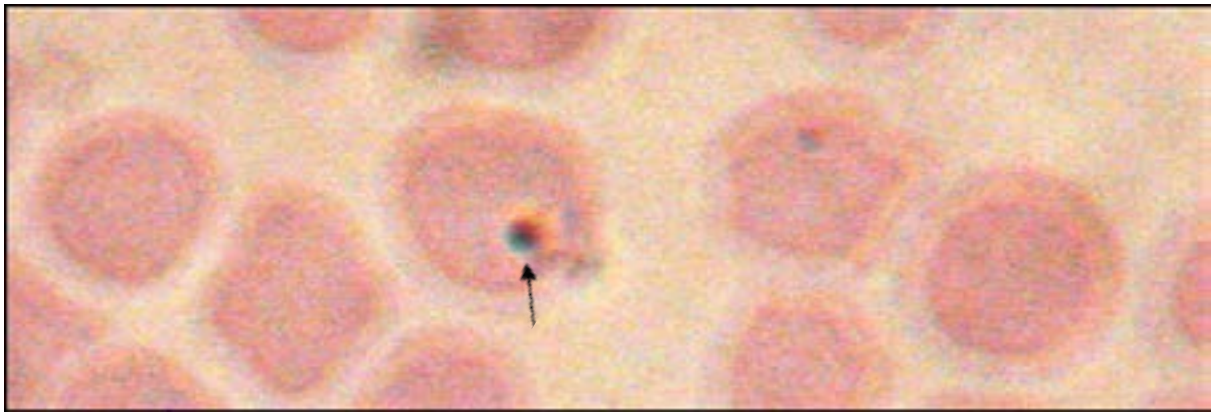

Fig. 5. Light micrograph of sheep blood smear with low parasitemia of *Theileria ovis* (anaplasma-like shape) (Arrow, magnification X 1000). Scale: 1cm ≡ 6µm

Lymph Nodes Impression Smears

Impression smears taken from the lymph nodes of the above-mentioned Arabi breed ewe showed the presence of *Theileria*

lestoquardi microschizont in lymphocytes of this animal (Fig.6). No microschizont forms of this parasite detected in other cases.

Fig. 6. Light micrograph of sheep lymph node impression smear showing microschizont of *Theileria lestoquardi* (Arrow, magnification X 1000). Scale: 1cm ≡3µm

Prevalence of *Babesia* Infection

In this survey, 3211 small ruminants examined for *Babesia* infection. As shown in Table (1) 36.62%±4.03 of examined animals were infected. Table (1) shows the seasonal prevalence of *Babesia* infection in small ruminants in the Eastern Province. The obtained results revealed a prevalence of 34.02%±10.21, 45.19%±4.05, 41.43%±6.62 and 25.59%±8.97 during winter, spring, summer and autumn seasons respectively. The prevalence of infection in goats was 36.04%±4.23, while that of sheep was 37.27%±5.95. The highest seasonal prevalence of *Babesia* infection in small ruminants reported in this study was in spring (45.19%±4.05) and summer (41.43±6.62), followed by winter (34.02%±10.21) and then autumn (25.59%±8.97) (Table 1 and Fig. 7).

Table 1: Average seasonal prevalence of *Babesia* infection in small ruminants in the Eastern Province

Season	Goats		Sheep		Small ruminants	
	Samples	Infection %	Samples	Infection %	Samples	Infection %
Winter	397	30.29 ± 2.78^{ax}	381	35.08 ± 3.50^{cx}	778	34.02 ± 10.21^{a}
Spring	427	44.87 ± 2.01^{bx}	406	45.80 ± 2.84^{bx}	833	45.19 ± 4.05^{a}
Summer	431	37.25 ± 2.61^{cx}	373	44.93 ± 2.74^{by}	804	41.43 ± 6.62^{a}
Autumn	443	29.60 ± 2.62^{ax}	353	19.49 ± 3.95^{ay}	796	25.59 ± 8.97^{a}
Total	1698	36.04 ± 4.23^{x}	1513	37.27±5.95	3211	36.62±4.03

Mean value of different letter(s) per column (a-c) between seasons within species are significantly different at ($p<0.05$). Mean value of different letter(s) (x-y) between species within seasons are significantly different at ($p<0.05$).

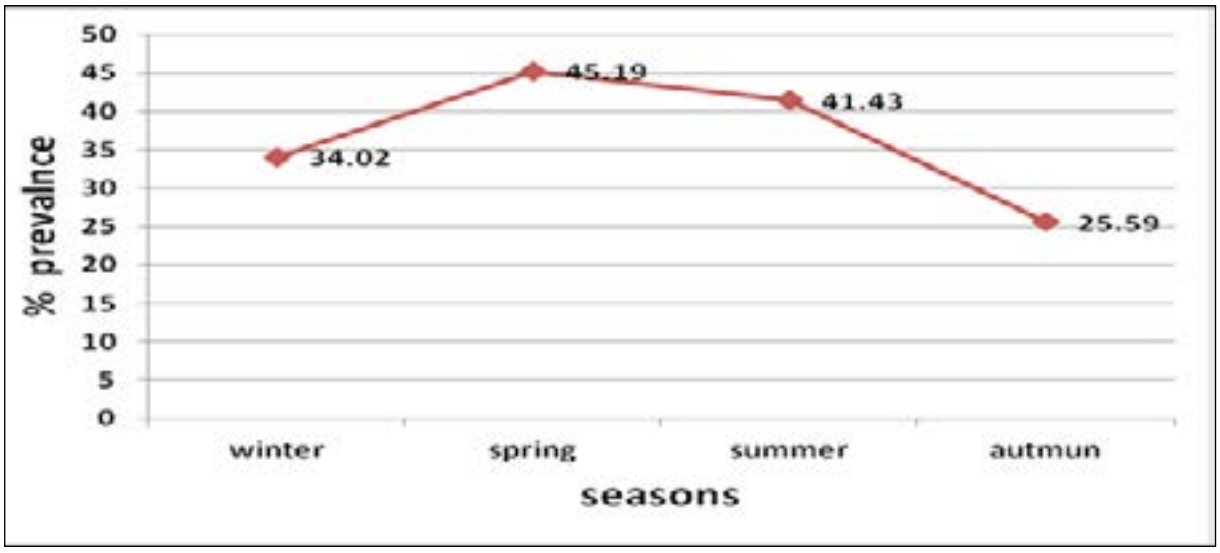

Fig. 7. Average seasonal prevalence of *Babesia* infection in small ruminants

Table (2) shows the monthly prevalence of *Babesia* infection in sheep and goats. The highest level of infection in goats reported in June reached 52.83%±2.85 and the lowest level observed was in December 10.68%±3.15. In sheep the highest level reported in March 59.90%±4.68 and infection ceased in October. Although the infection rate in both animal species is fluctuated throughout the year, the pattern of infection in goats starts to increase progressively from January to reach its peak level in June after which it decreases gradually toward December (Fig. 8). In sheep, high infection rate observed from January upwards, having two peaks in March and June, then level declined towards October, after which it started to rise again toward December (Fig. 9).

Table2: Monthly prevalence of *Babesia* infection in small ruminants in the Eastern Province

Months	Goats		Sheep	
	Sample	Infection(%)	Sample	Infection(%)
January	127	44.94±2.99	128	47.09±6.54
February	140	35.26±3.52	135	40.24±4.31
March	139	46.92±3.82	115	59.90±4.68
April	139	47.30±3.29	134	38.33±3.06
May	149	40.40±3.22	157	39.18±4.31
June	138	52.83±2.85	124	54.98±4.78
July	146	29.37±3.01	123	37.74±5.19
August	147	29.55±4.76	126	42.06±2.69
September	149	38.31±4.88	116	46.80±4.63
October	150	20.83±4.18	112	0.00±0.00
November	144	29.65±3.63	125	11.67±4.41
December	130	10.68±3.15	118	17.92±3.64
Total	1698	36.04±4.23	1513	37.27±5.95

Fig. 8. Monthly prevalence of *Babesia* infection in goats

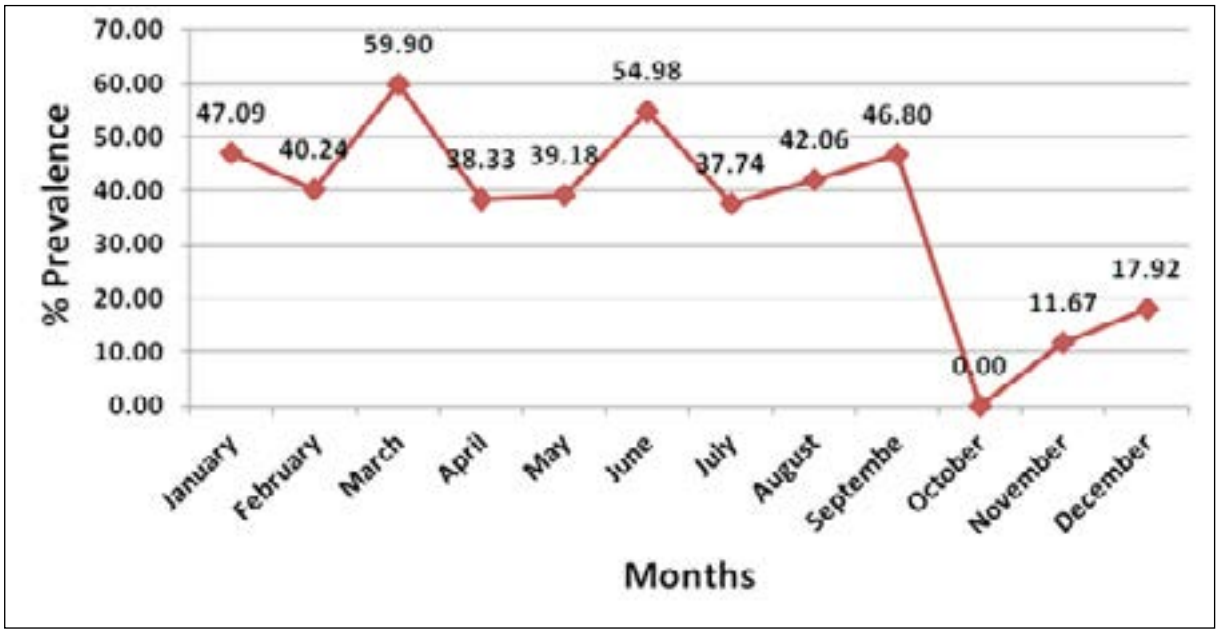

Fig. 9. Monthly prevalence of *Babesia* infection in sheep

Table (3) shows the susceptibility of different breeds of goats and sheep in the Eastern Province to *Babesia* infection. As shown in this table and in figure (10) the Ardi and Janobi breeds of goats are the most susceptible breeds, followed by crossbreed and the Shami breed. The Neimi sheep breed is the most susceptible followed by the Arabi sheep and the crossbreed (Table 3 and Figure 11).

Table 3: The susceptibility of different breeds of goats and sheep to *Babesia* infection

Animal	Breed	Infection%	Animal	Breed	Infection%
Goats	Ardi	44.58±2.44[a]	Sheep	Neimi	42.77±3.35[b]
	Janobi	42.62±2.30[a]		Arabi	35.96±3.08[a]
	Shami	17.82±1.91[b]		Crossbreed	30.25±3.00[c]
	Crossbreed	36.99±2.08[c]			

Mean value of different letter(s) per column (a-c) between breeds within species are significantly different at (0<0.05)

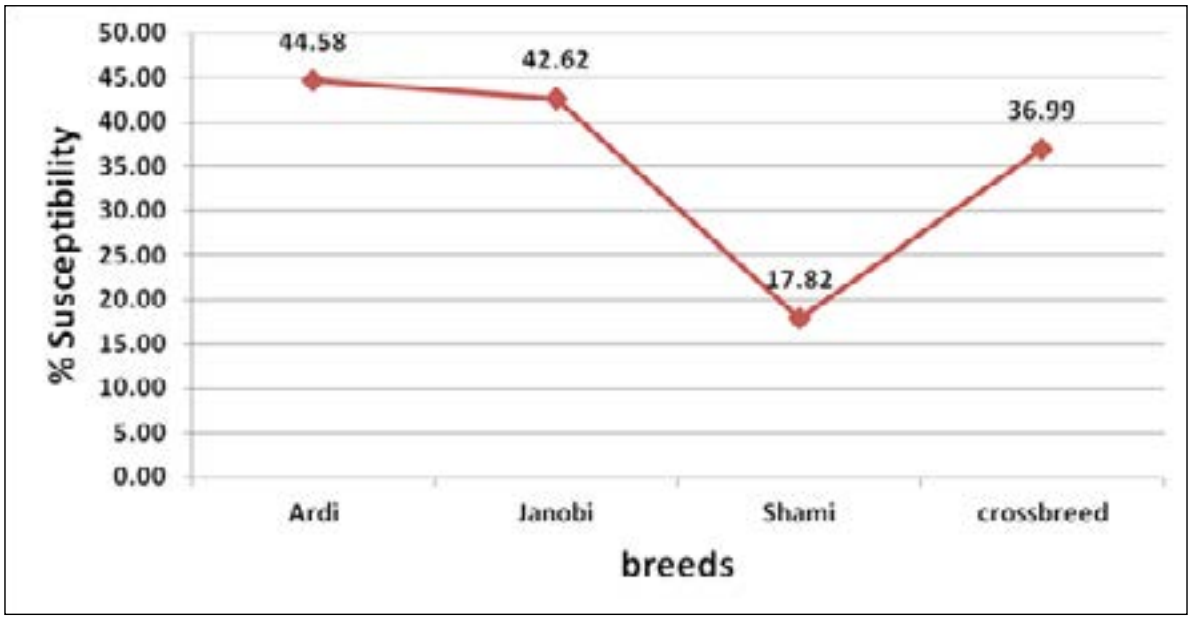

Fig. 10 Susceptibility of different breeds of goats to *Babesia* infection

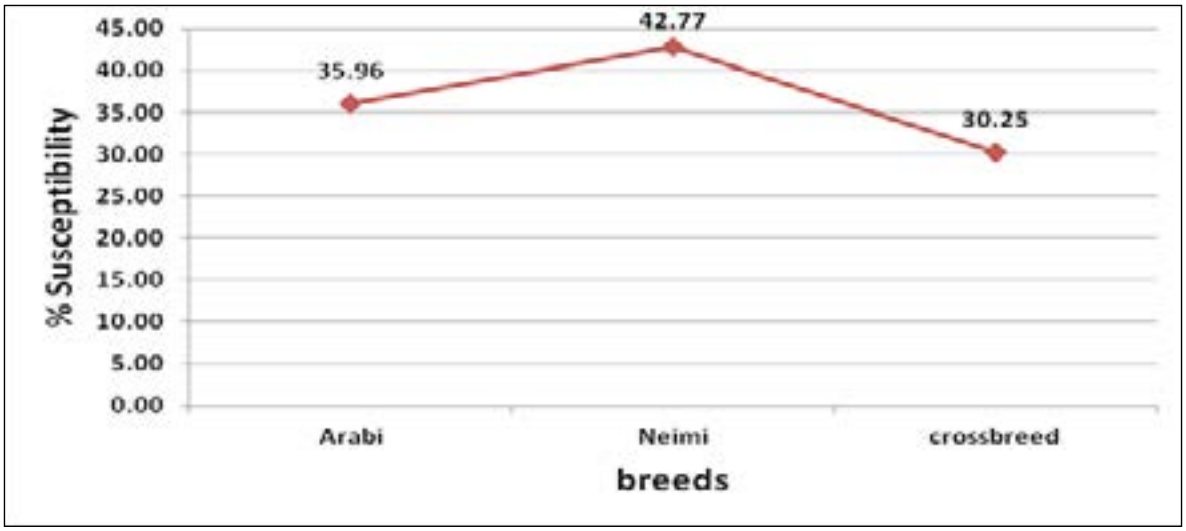

Fig. 11 Susceptibility of different breeds of sheep to *Babesia* infection.

Table (4) shows the susceptibility of different age groups of sheep and goats to *Babesia* infection. As shown in this table, animals over one year of age of both species are more susceptible to infection than those aging less than one year. Out of 863 goats and 775 sheep older than one year 38.80%±1.74 goats and 41.43%±2.92 sheep were positive to infection. While only 32.20%±1.96 out of 835 goats under one year of age were positive, and 31.23%±2.14 out of 738 sheep less than one year were infected.

Table 4: Susceptibility of different age groups of goats and sheep to *Babesia* infection

Animals	< 1year		>1year	
	Samples	Infection (%)	Samples	Infection (%)
Goat	835	32.20 ± 1.96^{ax}	863	38.80 ± 1.74^{ay}
Sheep	738	31.23 ± 2.14^{ax}	775	41.43 ± 2.92^{ay}

Mean value of different letter(s) (a-c) between ages within species are significantly different at (0 <0.05). Mean value of different letters (x-y) between species within age are significantly different at (0<0.05).

Table (5) illustrates the susceptibility of different sexes of goats and sheep to *Babesia* infection. No significant difference in susceptibility to infection was found in different sexes of both animal species. Out of 863 female goats and 823 ewes, 36.53%±1.90 female goats and 38.44%±2.41 ewes were found infected and 34.47%±1.86 out of 722 male goats and 34.21%±2.82 out of 690 male sheep were infected.

Table 5: Susceptibility of different sexes of goats and sheep to *Babesia* infection

Animals	Female		Male	
	Samples	Infection%	Samples	Infection%
Goat	863	36.53 ± 1.90^{ax}	722	34.47 ± 1.86^{ax}
Sheep	823	38.44 ± 2.41^{ax}	690	34.21 ± 2.82^{ax}

Mean value of different letter(s) (a-c) between species within sex are significantly different at (0<0.05).
Mean value of different letters (x-z) between sex within species are significantly different at (0<0.05).

Prevalence of *Theileria* infection

In this study, *Theileria* infection was detected in only two sheep with a prevalence rate of 0.13%. The infected sheep were an Arabi breed harboring *T. lestoquardi* and eventually died and a Neimi breed harboring *T. ovis* which was apparently healthy.

Tick identification

The tick genera identified from sheep and goats included *Rhipicephalus* sp. and *Hyalomma* sp. *Rhipicephalus* was the predominant genus infesting both sheep and goats. The ticks found attached only on the wool-less parts of head and especially on and around the ears (Fig.12). Most of *Hyalomma* ticks were, collected from one Arabi sheep that was heavily infested with ticks on different parts of its body.

Fig. 12: Arabi sheep ear infested with ticks (Arrow).

DISCUSSION

In this study, diagnosis of small ruminant babesiosis and theileriosis was based on clinical signs combined with host specificity and morphological identification of parasites in Geimsa stained blood and lymph node smears. Both piroplasms, babesiae and theileriae, were found to infect small ruminants in the study area. This is in agreement with the findings of Al-Khalifa *et al*. (2009) who reported both *Babesia* spp. and *Theileria* spp. in small ruminants in Eastern Province of Saudi Arabia.

Small ruminants Babesiosis is caused by infection with *Babesia ovis, B. motasi* and *B. crassa* (Uilenberg 2006). *Babesia* spp. are classified according to their size and vertebrate host (Euzepy 1987; Soulsby1986; Laha *et al*., 2015) and accordingly, these species fall into two major groups: large forms with an average length of more than 3µm and small forms which have an average length of less than 2.5µm. Among *Babesia* infecting small ruminants, *B. motasi* and *B. crassa* are recognized as large forms, and *B. ovis*, *B. taylori* and *B. foliate* are recognized small forms. Both large form *B. motasi* and small form *B. ovis* are reported in the present study. Al-Khalifa *et al*. (2009), however, reported only *Babesia motasi*, in the Eastern province of Saudi Arabia. The long time span between the first study (1990 – 1991), conducted by Al- Khalifa *et al*. (2009), and the present study may have allowed a better adaptation of the vector to local conditions. The differential discrimination of *Babesia* spp. in the present study was based on the morphometrical parameters. Although,

Yeruham *et al*. (1998) and Aktas *et al*. (2007) reported that the common erythrocytic forms, of *B. ovis*, are mature double pyriform and single ring, small *Babesia* described here is closely resembling *B. ovis* described by Soulsby (1986). *B. ovis* described by Soulsby (1986) is a small *Babesia* being 1-2.5 µm in length, round or rare pyriform having obtuse angle and found at the margin of red blood cells. In the present study, the shapes of the small parasites inside red cells were mostly single, double round parasites and comparatively rare single pyriform and mature double pyriform having obtuse angle observed at the margin of red blood cells.

Morphologically, large *Babesia* piroplasms described in the present study, were polymorphic, including single and paired pyriform, single ring, double ring, rod-shaped, irregularly shaped or budding forms and the angles between the two pyriform piroplasms were mostly acute. According to the observed morphological data and pathogenicity, large *Babesia* described in this study are relatively resembling those described by Bai *et al*. (2002) and Soulsby (1986). Soulsby (1986) described *B. motasi* as a large *Babesia* being 2.5-4×2µm in diameter with acute angle between pyriforms. Bai *et al*. (2002) described *B. motasi* as large polymorphic *Babesia*, being double or single pyriform, ring form, rod-like, three leaved or budding forms. Infection with this parasite is severe with parasitemia reaching up to 23.7% and high mortality particularly in lambs and imported small ruminants. In conclusion, according to the morphology and predominant tick vector reported in the present study the two species of *Babesia* infecting small ruminants in Eastern Province, are *Babesia ovis* and *Babesia motasi*. However, more investigation in their genetic identity is recommended since morphometrical parameters alone are not the best tools for differential discrimination of *Babesia* spp. (Sadeghi *et al*., 2010). Liu *et al*. (2007) and Shayan *et al*. (2008) described new large *Babesia* species infective to sheep and goat morphologically similar to *Babesia motasi* while genetically distinctive from it.

Small ruminant theileriosis is caused by a number of *Theileria* species, including *Theileria lestoquardi*, *T. ovis*, *T. separata*, *T. recondite*, (Uilenberg 1981, Abdullah et al., 2010) and *T. luwenshuni* and *T. uilenbergi*, that cause sheep theileriosis in China (Yin *et al*., 2007), in addition to *T. annulata* and *Theileria* spp. OT1 (Al-Fahdi *et al*., 2017). *T. lestoquardi* and *T. luwenshuni* are highly pathogenic and cause lympho-proliferative syndrome characterized by high mortality and morbidity (Yin *et al*., 2003; Yin *et al*., 2007), while *T. ovis*, *T. separata* and *T. recondite* are of low or non-pathogenic effect in small ruminants (Uilenberg 1981). Schizogony frequently determines the severity of the disease during the reproductive cycle of the parasite. In non-pathogenic theileriosis, there are few schizogonies of this type (Morel 1989). The diagnosis of theileriosis is based on clinical signs, epidemiological data and examination of piroplasms or schizonts in stained smears of blood and lymph node (El Imam and Taha 2015). In the present study, both *T. lestoquardi* and *T. ovis* detected in sheep but not in goats. These results are not in agreement with the results reported by Hussein *et al*. (1991) who reported *T. lestoquardi* and *T. ovis* in both sheep and goats. This could be, attributed to the distribution of the vectors in the area. Differentiation between *T. lestoquardi* and *T. ovis* was, made according to Uilenberg (1981) and was based on prevalence in the former and scarcity or absence from the latter of schizonts in lymphocytes. In the present study, malignant theileriosis reported in a single sheep, Arabi breed, brought to Al-Dammam Veterinary Clinic and according to the owner about 25% of the flocks died during three weeks. The affected animal showed high parasitemia in red blood cells and examination of impression smears of pre-scapular lymph nodes revealed the presence of schizonts in lymphocytes suggesting infection with *T. lestoquardi*. This animal showed severe clinical signs manifested by high fever (40^{o}C), emaciation, pale mucous

membranes, and enlargement of superficial lymph nodes, respiratory distress, and diarrhea and eventually died. Similar clinical signs reported by Tageldin *et al*. (2005) in Omani sheep. On the other hand, animals infected with *T. ovis* were apparently healthy and only scarce piroplasms detected in their red blood cells. Indeed, *T. lestoquardi* and *T. ovis* were previously reported in different regions of Saudi Arabia (Hussein *et al.,* 1991; El-Metenawy 1999; El-Azazy *et al*., 2001; and Al-Khalifa *et al*., 2009).

In the present study, *Theileria* infection was only reported in sheep with a prevalence of about 0.13%. This low infection rate could be attributed to many factors, that include limitation of the tick vector distribution and scarce parasitemia that cannot be detected by traditional method used in this study. Similar result was reported in Taif abattoir, Saudi Arabia, in indigenous Harri breed sheep (Shalaby *et al*., 2011). *T. lestoquardi* was, detected only in an adult sheep in the present study. Ticks of the genus *Hyalomma* and *Rhipicephalus* are responsible for transmission of *T. lestoquardi* (El-Azazy *et al*., 2001; Razmi *et al.,* 2003). In the present study, the tick genera identified from sheep and goats were *Rhipicephalus* and *Hyalomma*. El-Azazy *et al*. (2001) found *H. a. impeltatum* as the predominant tick species-infesting sheep in Al-Qassim Region, Saudi Arabia and concluded that it may be the vector of malignant theileriosis. In the present study, most of *Hyalomma* ticks collected from one Arabi sheep that was heavily infested with ticks and the ticks were in different parts of the body. This may clarify the low incidence of small ruminant theileriosis in the study area.

Using blood film examination in the present study, the prevalence of *Babesia* infection reached 37.27%±5.95 in sheep and 36.04%±4.23 in goats with an overall prevalence of 36.62%±4.03 in small ruminants. A prevalence of only 4% reported previously in this area by Al-Khalifa *et al*. (2009). Such variation in the prevalence may be attributed to long time span between the two studies and consequently variation in vector activity. The present study showed that *Babesia* infection in small ruminants is widespread in the surveyed areas of Eastern Province and provided strong evidence that infection with this parasite is endemic in this area. The continuous exposure of animals to infected ticks in an endemic area increases the stability of the prevalence of babesiosis (Morel 1989). Chronic low *babesia* parasitemia in the vertebrate host and transovarial and transstadial transmission in the tick vector allows long-term persistence of *Babesia* spp. in the endemic area (Chauvin *et al.,* 2009). The present study also, showed a significant difference in the prevalence of *Babesia* in different age groups of small ruminants where animals aging over one year were most susceptible to infection. An inverse age resistant is a common feature of babesiosis (Urquhart *et al*., 2006). Similar to the finding of Razmi *et al*. (2003), animal sex in the present study showed no significant difference in the prevalence of infection.

Regarding seasonal variation of prevalence of *Babesi*a spp., the highest prevalence rate in examined animals in the present study was detected in spring, followed by summer. Similar pattern reported in Siwa Oasis, Egypt by Hosein *et al*. (2007) who considered spring and summer as seasons of high activity of tick vector.

In conclusion, the present study revealed the presence of both *Babesia* and *Theileria* species in small ruminants in surveyed area. Morphological characterization and clinical observations demonstrated the presence of *B. ovis*, *B. motasi*, *T. ovis* and *T. lestoquardi*. Small ruminants' babesiosis is widespread in the surveyed area of Eastern Province and consequently providing strong evidence that it is endemic in this area. Such data should be made available to the concerned governmental authorities and also extended to animals owners in the study areas to adopt prophylactic and preventive measures against tick borne hemoprotozoan diseases. It is worth mentioning that, according to the obtained data from the present study,

the Ministry of Agriculture introduced the chemotherapeutic agent Imidocarb in the study area and it greatly decreased the infection rate as indicated by reduced complaints from the owners. On the other hand, the prevalence of *Theileria* infection reported in the present study was very low and the parasites were detected only in sheep. The infestation of small ruminants by *Rhipicephalus* and *Hyalomma* ticks suggests an important role for these ticks in the transmission of *Babesia* and *Theileria* parasites to these animals. Moreover, experimental studies are recommended to verify this role.

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المسح الطفيلي للأوالي الكمثرية المنقولة عن طريق القراد بالمجترات الصغيرة بالمنطقة الشرقية للمملكة العربية السعودية

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الملخص

في هذه الدراسة تم تحديد درجة انتشار طفيلي البابيزيا والثايليريا في الأغنام والماعز بالمنطقة الشرقية، وذلك عن طريق فحص مسحة الدم المصبوغة ومسحة الغدد الليمفاوية من هذه الحيوانات بالدمام، القطيف، الجبيل، كما تم أيضا تحديد تأثير جنس الحيوان وعمره على درجة الإصابة بهذه الأمراض، إضافة إلى تحديد نوعية القراد التي تصيب هذه الحيوانات.

شملت الدراسة عدد 3211 من الأغنام والماعز، وكانت نسبة الإصابة بطفيل البابيزيا 36.56 % ± 4.03 بينما بلغت نسبة الإصابة بطفيل الثايليريا 0.06 % فقط. أنواع الطفيليات التي تم تعرُّفها في هذه الدراسة شملت طفيليات بابيزيا أووفس، بابيزيا موتاسي، ثايليريا أووفس، ثايليريا ليستوكواردي. سجلت أعلى نسبة لمرض البابيزيا في فصلي الربيع (45.19 ± 4.05) والصيف (41.43 ± 6.62) يتبعها الشتاء (34.02 ± 10.21) وأقلها في الخريف (25.59 ± 8.97). أجناس القراد التي شخصت أثناء هذه الدراسة شملت الرايبسفالس والهيالوما. سلالات الماعز الأكثر عرضة للإصابة بالمرض كانت العارضي والجنوبي يتبعها الهجين ثم الشامي. أما في الأغنام فقد كان النعيمي هو الأكثر عرضة للإصابة يتبعه العربي ثم الهجين.

الحيوانات التي يزيد عمرها عن العام كانت أكثر عرضة للإصابة بالمرض مقارنة بالأعمار الصغيرة. أما جنس الحيوان فلم يكن له أثر على معدل الإصابة بالمرض. تمت مناقشة النتائج ووضعت الاستنتاجات والتوصيات.

الكلمات المفتاحية: انتشار، بابيزيا، ثايليريا، طفيليات الدم، لطخة انطباعية، محافظة.