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Fasciolosis due to *Fasciola hepatica* in ruminants in abattoirs and its economic impact in two regions in Algeria

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Abstract. A study of ruminant fascioliasis was conducted in Algerian abattoirs between March 2008 and February 2009. The aim of the study was to determine the prevalence of infected livers with fascioliasis and to evaluate the economic loss due to the condemnation of livers infected with fascioliasis. A total of 3,457 cattle, 6,161 sheep and 5,764 goats were slaughtered and examined in El Tarf abattoir, north Algeria (humid climate), and 2,151 cattle, 5,724 sheep, 351 goats and 582 camels in Ouargla abattoir, south Algeria (saharan climate). In El Tarf region, the prevalence of fascioliasis infection was 26.7±2.5%, 6.5±0.4% and 2.5±0.2% in cattle, sheep and goats, respectively (P<0.001). The seasonal prevalence of *Fasciola hepatica* was highest in summer and winter for cattle and goats and in winter for sheep (P < 0.001). In Ouargla region, fascioliasis is reported for the first time in cattle (1.7±0.7%). Sheep, goats and camels were not infected. The overall economic loss due to hepatic condemnations as a result of fascioliasis was estimated at 60,000 euros in El Tarf region and 4,000 euros in Ouargla region. According to this study, it can be concluded that fascioliasis is endemic in the northern Algeria in ruminants and, the disease should be considered seriously as a great threat to ruminant health and profitability.

INTRODUCTION

Fascioliasis is a cosmopolitan parasitic disease caused by *Fasciola hepatica* (Linné 1758). It affects a large variety of animals, such as sheep, goats, cattle, horses, donkey and camels (Dalton, 1999; Esteban *et al.*, 2003). It could be zoonotic while constituting a major economic problem by lowering the productivity of animals, in addition to losses from condemnation of affected organs. Sheep are the most sensitive species compared to cattle and goats (Haroun & Hillyer, 1986; Reinaldo Gonzalez *et al.*, 2002; Chauvin *et al.*, 2007). Fascioliasis is characterized by chronic, acute or sub-acute inflammation of the liver and bile ducts, submandibular oedema, anaemia, general intoxication, and death. Meat infected with *Fasciola hepatica* is regularly condemned at inspection in abattoirs (Dalton, 1999).

Fascioliasis is one of the most important ruminant helminthic parasites, particularly in northern Algeria where the conditions are more favorable for the survival of snails (intermediate host) (Mekroud *et al.*, 2004). In the abattoirs of Jijel area, north Algeria, fascioliasis prevalence in livestock was reported at 27.0% in cattle and 18.2% in sheep (Mekroud *et al.*, 2004). Whereas, in the abattoirs of Constantine (semi-arid area), low prevalences were reported, 9.1% in cattle and 8.5% in sheep (Mekroud *et al.*, 2004). The economic loss from liver condemnation as a result of fascioliasis is very high. A preliminary study, carried out at the abattoirs of Jijel, north Algeria, showed a loss of 10,000 euros per year (Mekroud *et al.*, 2004).

The present study was carried out to determine the prevalence of fascioliasis in cattle, sheep and, for the first time, in goats and dromedary in two different regions: El

Tarf (Humid climate), northeastern Algeria and Ouargla (Saharan climate), south Algeria. Economic losses were evaluated.

MATERIALS AND METHODS

Study areas

This study was conducted from March 2008 to February 2009 in abattoir of two regions: El Tarf and Ouargla. El Tarf region is geographically located at the northeastern part of Algeria and has a humid climate with a mean temperature of 12 and 28°C during winter and summer, respectively. The mean annual precipitation reaches 700 mm. Ouargla region, located in the south of Algeria, has a saharan climate and the mean temperature during winter is 6.6°C and during summer is 43.9°C. The annual precipitation in this region is very low; it is 33.5 mm (ONM, 2001).

Animals

A total of 3,457 cattle, 6,161 sheep and 5,764 goats slaughtered at El Tarf abattoir and 2,151 cattle, 5,724 sheep, 351 goats and 582 camels slaughtered at Ouargla abattoir, were daily inspected for the presence of liver fascioliasis which efficiently inspected by naked eye, palpation and by making multiple incisions at the biliary tract to check the presence of the parasite.

Economic evaluation

Total numbers of whole and/or parts of livers that were condemned during meat inspection were recorded for each animal slaughtered and inspected in El Tarf and Ouargla abattoirs in the course of this study. Economic loss as a result of liver condemnation was estimated considering the total mass of liver condemned during the survey multiplied by the cost of one kilogram of liver in Algeria.

Statistical Analyses

ANOVA and multiple range tests were used to compare prevalences of fascioliasis in different animal species. Principle component analysis (PCA) of these prevalences was performed in R 3.0.1 (R Core Team, 2013), and the package ggplot2 was used to plot results. Chi square test was used to compare the seasonal prevalences. The threshold value of different tests was $P<0.05$.

RESULTS

The prevalence of fascioliasis in El Tarf region was found to be 26.7±2.5; 6.5±0.4 and 2.5±0.2% in cattle, sheep and goats, respectively (Table 1) ($P<0.001$).

The monthly infection prevalence in cattle varied between 10.5±2.9 and 50.4±3% in April and July, respectively (Table 1). Two infection peaks were recorded, one in summer (35.0%) and the second in winter (31.6%) (Figure 1) ($P<0.001$).

For sheep, the prevalence of fascioliasis varied from 1.1±0.2% (in August) to 21.2±1.7% (in December) (Table 1). The highest prevalence rate was observed during winter season (9.2%) ($P<0.001$) (Figure 1).

In goats, the prevalence of fascioliasis varied between 0.9±0.2% in March and 6.2±1.5% in April (Table 1). The seasonal prevalence was highest during summer season (3.6%) and winter season (2.8%) ($P<0.01$) (Figure 1).

In Ouargla region, fascioliasis was almost absent, except for a few cases in cattle (1.7±0.7%) (Table 1). Statistical analysis of the data revealed no statistically significant association between fascioliasis prevalence and the seasons ($P>0.05$) (Figure 1). Sheep, goats and camels were not infected.

As illustrated in Figure 2, results of the PCA test revealed that fascioliasis prevalence in El Tarf region is higher than Ouargla region.

Total of 2,693; 470 and 152 kg of cattle's, sheep and goats' livers were condemned in El Tarf during the survey period, resulting in higher economic loss of 60,000 euros.

In Ouargla, 222 kg of cattle's livers masse were condemned giving a total loss equal to 4,000 euros.

Table 1. Number of ruminants slaughtered and prevalence of livers infected with fascioliasis in abattoirs of El Tarf and Ouargla regions

Months	Number of ruminants slaughtered in El Tarf			Number of livers infected with fascioliasis in El Tarf (%)			Number of ruminants slaughtered in Ouargla	Number of livers infected with fascioliasis in Ouargla (%)
	Cattle	Sheep	Goats	Cattle	Sheep	Goats	Cattle	Cattle
March 2008	186	238	433	41 (22±2)	27 (11.3±1.2)	4 (0.9±0.2)	159	2 (1.2±0.5)
April	609	334	402	64 (10.5±4.9)	29 (8.6±0.5)	25 (6.2±1.5)	254	4 (1.5±0.3)
May	235	347	443	80 (34±3)	22 (6.3±0.5)	6 (1.3±0.3)	263	5 (1.9±0.4)
June	299	314	430	87 (29.1±3.8)	23 (7.32±1)	10 (2.3±0.9)	222	4 (1.8±0.4)
July	305	279	361	154 (50.5±3.1)	20 (7.1±0.4)	9 (2.5±0.4)	92	1 (1.1±0.4)
August	358	1272	464	96 (26.8±2)	14 (1.1±0.2)	27 (5.8±1.4)	135	1 (0.7±0.5)
September	539	1859	1406	136 (25.2±2.6)	179 (9.6±0.8)	15 (1.1±0.1)	191	2 (1±0.5)
October	244	555	537	62 (25.4±3.4)	13 (2.3±1)	14 (2.6±0.1)	153	4 (2.6±0.7)
November	230	445	451	63 (27.3±3.4)	26 (5.8±1.1)	12 (2.6±1)	246	3 (1.2±0.3)
December	98	66	171	31 (31.6±2.4)	14 (21.2±1.7)	3 (1.7±0.1)	110	5 (4.5±1.2)
January 2009	159	126	245	49 (30.8±1.3)	15 (11.9±1.5)	11 (4.5±1)	115	3 (2.6±1.2)
February	195	326	421	63 (32.3±2.2)	19 (5.8±0.3)	10 (2.3±0.4)	211	3 (2.8±1.2)
Total	3457	6161	5764	926 (26.7±2.5)*	401 (6.5±0.4)*	146 (2.5±0.2)*	2151	37 (1.7±0.7)

* Indicates a statistically significant difference.

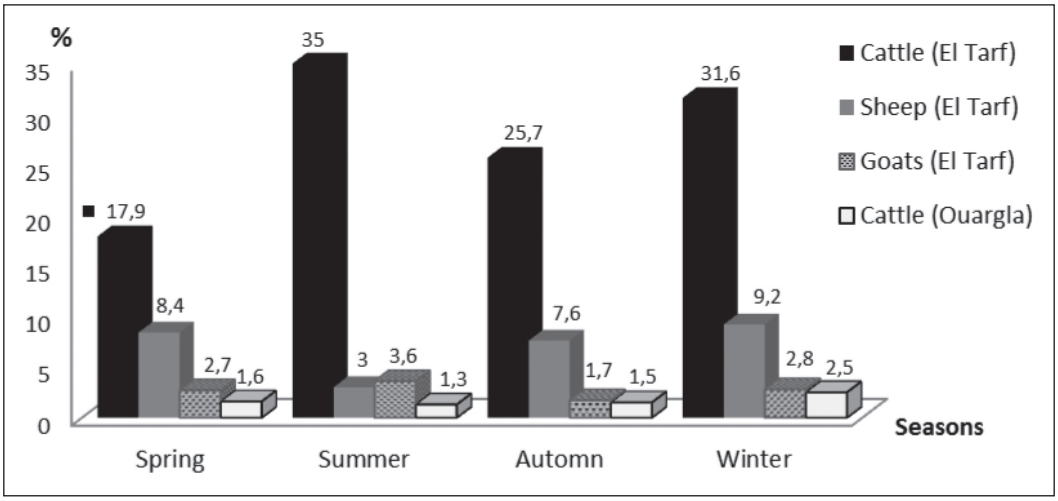

Figure 1. Seasonal infection prevalence of hepatic fascioliasis in cattle, sheep and goats at El Tarf area and in cattle at Ouargla area.

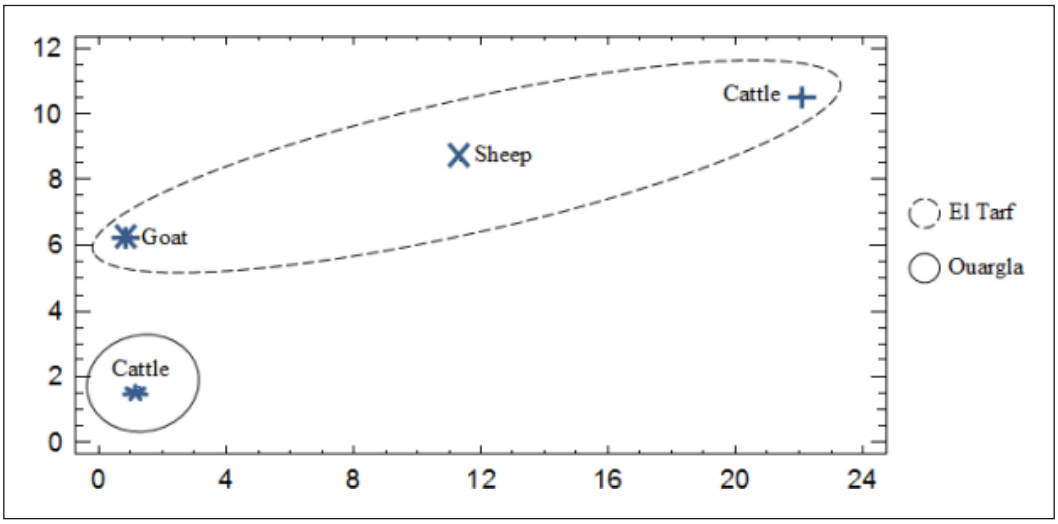

Figure 2. Principle component analysis (PCA) for fascioliasis prevalence in El Tarf (cattle, sheep and goats) and Ouargla (cattle) regions.

DISCUSSION

The prevalence of fascioliasis in animals depends on several factors that include the environment, the climate and the choice of diagnostic methods. High prevalence has been reported in cattle in areas with humid climates (Mas-Coma, 2008; Bhutto *et al.*, 2012).

Several studies have reported varying prevalences in cattle. Gimard (2001), in France, revealed prevalence of 3.7% to 10.8% in cattle slaughtered according to breed. Blaise & Raccurt (2007), in Haiti, reported a prevalence of 10.7%. A prevalence of 52.2% was reported in Australia (Molloy *et al.*, 2005).

In our study in El Tarf region (humid climate), 3,457 cattle were slaughtered in abattoirs of which 926 (26.7±2.5%) revealed infected with fascioliasis. Similar results have been reported from Jijel region (humid climate), Algeria by Mekroud *et al.* (2004 & 2006), which revealed, 27.0% and 23.0% prevalence in cattle infected with fascioliasis.

Two peaks of prevalence were observed in cattle, in our study, one in summer and the second in winter. This is in accordance with the findings of Mekroud *et al.* (2002) in Algeria and Mrifag *et al.* (2012) in Morocco.

Prevalence of fascioliasis in sheep, varies widely; 35.0% in Tunisia (Jemli *et al.*, 1991), 30.9% in Bangladesh (Al-Mamun *et al.*, 2011), 37.5% in Mexico (Nahed-Toral *et al.*, 2003), 26.5% in Australia (Molloy *et al.*, 2005) and 6.0% in Pakistan (Ullah *et al.*, 2013). Blaise & Raccurt (2007), in Haiti, reported only 3.2%.

In our study, prevalence of fascioliasis in sheep (6.5±0.4%) is lower than the result observed by Mekroud *et al.* (2006) (16.0%) in Jijel area.

Anthelmintics were used for treatment of fascioliasis, especially in sheep, during two periods in the year (October-November, and March-April) which explains the low prevalence of fascioliasis in sheep. Similar results were observed by Ullah *et al.* (2013; 2016).

In Tunisia, Jemli *et al.* (1991) reported that fascioliasis was seen predominantly during summer season. In the present study, the prevalence of fascioliasis in sheep was less in summer season and higher in winter season.

Prevalence of fascioliasis in goats is habitually low and it varied between 0.9% and 3.6% (Achi *et al.*, 2003; Blaise & Raccurt, 2007; Jibat *et al.*, 2008). Our finding (2.5±0.2%) is in this interval.

In Ouargla region, the present study, revealed for the first time in Algeria, the presence of the parasite in cattle (1.7±0.7%). Sheep, goats and camels were not infected.

Results of the PCA test revealed that prevalence of fascioliasis among cattle in El Tarf region was higher than Ouargla region, and attributed this to the climatic conditions of El Tarf which favour the survival of the intermediate hosts, the snail.

In our study, no cases have been observed in camels and reported to be due to unfavorable climatic conditions in Ouargla region.

The economic loss incurred as a result of condemnation of liver infected with fascioliasis in El Tarf region was 60,000 euros and in Ouargla region it was 4,000 euros. A preliminary study, carried out at the abattoirs of Jijel, northeastern Algeria, revealed 10,000 euros loss per year due to the condemnation of liver infected with fascioliasis (Mekroud *et al.*, 2004). Ouchene *et al.* (2016), in Algeria, reported an average loss of 48,000 euros as a result of condemnations of ruminants liver and lungs infected with cystic echinococcosis. These values, leads us to think about a new plan of treatment against fascioliasis and to look for possible anthelmintic resistance as it has been reported in some studies, the resistance of *F. hepatica* against the drug triclabendazole, the treatment of choice for this parasite (van Dijk *et al.*, 2010; Fox *et al.*, 2011; Caminade *et al.*, 2015).

CONCLUSION

It is clear that fascioliasis remains common in Algeria in ruminants, particularly in the north. Direct losses due to the condemnation of livers infected are very high. For this purpose, it is necessary to adopt more practical approaches to control this infection and limit the contamination of animals to pastures to reduce economic losses. Knowledge of the genetic structure of *F. hepatica* in Algeria is critical to understanding the level of gene flow within *F. hepatica* populations and how this impacts on the spread essentially of drug resistance genes.

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