

Parasitic infection of livers and lungs in cattle and sheep in Constantine slaughterhouses, Algeria, in 2009-2018

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Keywords

Sheep, cattle, *Fasciola hepatica*, echinococcosis, abattoirs, morbidity, Algeria

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Summary

A retrospective study was carried out from registers of the slaughterhouses of Constantine, Algeria, on 145,919 cattle and 345,282 sheep apparently healthy, slaughtered between 2009 and 2018. The objective was to estimate the prevalence of the two dominant parasitic infections which cause gross lesions in liver and lungs, i.e. cystic echinococcosis (CE) and *Fasciola hepatica* infection. The postmortem examination consisted in a visual inspection of the organs, palpation of lungs and livers, and systematic incision of livers, performed according to FAO procedures. The prevalence of *F. hepatica* infection was significantly higher in cattle (2.7%) than in sheep (0.2%). There was a non-significant decrease from 4.5 to 2.0% ($p > 0.05$) in the prevalence of *F. hepatica* in cattle during the 10-year period. The prevalence of CE in the livers and lungs was significantly higher in cattle (3.3% and 9.7%, respectively) than in sheep (0.6% and 1.1%, respectively). The prevalence of CE was significantly higher in lungs than in livers. These results showed the importance of these parasitic infections in the province of Constantine and its surroundings, which requires the implementation of control programs against these infections in both sheep and cattle.

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■ INTRODUCTION

Slaughterhouses play a very important role in animal health surveillance and ensure meat traceability and meat safety for consumers. It can even be considered as an animal and zoonotic diseases control tool. Indeed, in order to detect diseases accurately and determine their origin, slaughterhouses represent a cheap and simple data source for veterinary services.

Cystic echinococcosis (CE), caused by *Echinococcus granulosus* metacestode, is one of the most widespread anthroozoonoses around the world. It is endemic in the Mediterranean Basin (Bardonnet et al., 2003; Azlaf and Dakkak, 2006; Lahmar et al., 2007, 2013; Borhani

et al., 2020). According to the World Organisation for Animal Health (2020), one million people around the world are infected by *E. granulosus*, and an estimated burden of 183,573 (range: 88,082–1,590,846) disability-adjusted life years has been ascribed to CE (Borhani et al., 2020). The incidence rate of CE is 2.1 cases per 100,000 person-years in endemic regions. Furthermore, high prevalence levels (5 to 10%) have been reported in Argentina, Peru, East Africa, Central Asia and China. Hyperendemic areas of South America have prevalences in slaughterhouses that vary from 20 to 95% of slaughtered animals (WHO, 2020).

In Northern Africa, the following data are available. In Tunisia, the yearly cost of CE has been estimated at US\$ 19 million (Majorowski et al., 2005). In Algeria, dog and human CE are endemic (Zeghir-Boute-dja et al., 2017), with a prevalence of 15.5–42% in dogs (Deplazes et al., 2017) and an incidence of 2.1 cases per 100,000 inhabitants in humans. There is a clear association with the high infection prevalence (78%) in sheep (Deplazes et al., 2017). In several developing countries, dogs are often contaminated with *E. granulosus* due to offal consumption in slaughterhouses (Lahmar et al., 2013) which maintains the infection. The life cycle of *E. granulosus* is fundamentally domestic and occurs among dogs and livestock species. Humans infected by the metacestode are therefore viewed as aberrant

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hosts (Chihai et al., 2016). In order to prevent the transmission of the infection in humans, WHO recommends a panel of measures such as periodic deworming of dogs, hygiene improvement during animal slaughtering including proper destruction of infected offal, and public education campaigns.

Fasciola hepatica infection is an important cause of productive and reproductive losses in animals, which can also lead to death (Ola-Fadunsin et al., 2020). This infection affects sheep, goats, cattle, buffaloes and camels, as well as other herbivores (mainly horses). The infection rate can be as high as 90% in endemic areas (Frag, 1998). Fascioliasis is also an emerging zoonosis affecting people in a wide range of countries such as Egypt, Bolivia, Peru, Ecuador, France, Portugal, Iran and China (Frag, 1998). In Algeria, several *F. hepatica* infection cases were found in different slaughterhouses of the country. The prevalence rates assessed in cattle were highly variable, estimated to be 9.1% in Constantine and 27% in Jijel (Mekroud et al., 2004), 52.4% in El Tarf (Boucheikhchoukh et al., 2012), and 2.8% in Bejaia (Ayad et al., 2019). The financial losses due to *F. hepatica*, associated to liver condemnation, were estimated at 10,000 euros per year in Jijel (Northeast of Algeria) (Mekroud et al. 2004).

CE and *F. hepatica* infections in ruminants cause high economic losses and affect animal growth, the qualitative and quantitative production of meat, milk and wool, seizures of organs at the slaughterhouse, and mortality (Lahmar et al., 2007; 2013; Ola-Fadunsin et al., 2020). They are also zoonoses. To address concerns related to slaughtering and safety of animal products, this study was carried out to estimate the prevalence of these two parasitic infections in sheep and cattle.

MATERIALS AND METHODS

Animals

The number of ruminants in the province of Constantine (Northeastern Algeria), where the present study was conducted, is estimated between 40,000 and 45,000 cattle, and 200,000 sheep (Direction des services agricoles, 2019, unpubl.). In order to assess the prevalence of CE and *F. hepatica* infections leading to confiscation of viscera, mainly lungs and livers, data on 491,201 animals (145,919 cattle and 345,282 sheep) slaughtered in apparently healthy condition in the eight slaughterhouses of the province of Constantine between 2009 and 2018 were examined. These animals came mostly from localities of the province but, due to lack of traceability, the exact origin of all the slaughtered ruminants was unknown. Postmortem examination consisted of visual inspection of the organs, palpation of lungs and livers, and systematic incisions of livers performed according to FAO procedure.

Statistical analysis

The data were entered in Microsoft Office Professional Plus 2016 Excel. Statistical analyses were performed with R software version 3.6.2 (R Core Team, 2019), and RStudio environment version 1.2.5033 (RStudio Team, 2019). A linear regression and Chi square test were performed.

RESULTS AND DISCUSSION

Prevalence of Fasciola hepatica infection

During the study period, the overall prevalence of *F. hepatica* infection was 0.2 and 2.7% in sheep and cattle, respectively (p < 0.001) (Tables I and II). Between 2009 and 2018, it decreased in cattle from 4.5 to 2.0% (Figure 1). Even if this decrease was not significant (p > 0.05), it could be an indication of the first good results of

Table I: Prevalence of Fasciola hepatica infection and cystic echinococcosis in cattle slaughtered (N) in slaughterhouses of the province of Constantine in Algeria (2009-2018) // Prévalence de l'infection à Fasciola hepatica et du kyste hydatique chez les bovins abattus (N) dans les abattoirs de la province de Constantine en Algérie (2009-2018)

Year	N	Num. of infected cattle (%)		
		Fasciolosis	Cystic echinococcosis	
			Liver lesion	Lung lesion
2009	10,961	497 (4.5)	482 (4.4)	928 (8.5)
2010	13,159	468 (3.6)	494 (3.8)	925 (7.0)
2011	13,620	697 (5.1)	576 (4.2)	899 (6.6)
2012	13,013	353 (2.7)	308 (2.4)	727 (5.6)
2013	14,225	546 (3.8)	453 (3.2)	1,323 (9.3)
2014	14,788	299 (2.0)	369 (2.5)	1,533 (10.4)
2015	13,676	212 (1.6)	160 (1.2)	2,413 (17.6)
2016	13,321	243 (1.8)	326 (2.4)	1,091 (8.2)
2017	19,629	306 (1.6)	662 (3.4)	1,868 (9.5)
2018	19,527	384 (2.0)	981 (5.0)	2,459 (12.6)
Total	145,919	4005 (2.7)	4,811 (3.3)	14,166 (9.7)

Table II: Prevalence of Fasciola hepatica infection and cystic echinococcosis in sheep slaughtered (N) in slaughterhouses of the province of Constantine in Algeria (2009-2018) // Prévalence de l'infection à Fasciola hepatica et du kyste hydatique chez les ovins abattus (N) dans les abattoirs de la province de Constantine en Algérie (2009-2018)

Year	N	Num. of infected sheep (%)		
		Fasciolosis	Cystic echinococcosis	
			Liver lesion	Lung lesion
2009	36,900	63 (0.2)	174 (0.5)	382 (1.0)
2010	49,084	105 (0.2)	148 (0.3)	235 (0.5)
2011	42,438	50 (0.1)	98 (0.2)	270 (0.6)
2012	33,343	251 (0.8)	203 (0.6)	54 (0.2)
2013	30,647	17 (0.1)	54 (0.2)	203 (0.7)
2014	28,282	113 (0.4)	123 (0.4)	372 (1.3)
2015	25,455	32 (0.1)	74 (0.3)	335 (1.3)
2016	22,340	28 (0.1)	110 (0.5)	183 (0.8)
2017	33,082	43 (0.1)	265 (0.8)	473 (1.4)
2018	43,718	115 (0.3)	680 (1.5)	1,239 (2.8)
Total	345,289	817 (0.2)	1,929 (0.5)	3,746 (1.1)

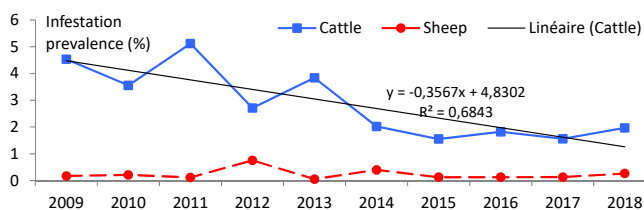


Figure 1: Annual prevalence of fasciolosis in cattle and sheep slaughtered in the Constantine slaughterhouses in Algeria (2009-2018) // Prévalence annuelle de la fasciolose chez les bovins et les ovins abattus dans les abattoirs de Constantine en Algérie (2009-2018)

the control programs implemented in cattle herds. The prevalence in sheep remained low during the whole survey period and did not significantly change, varying between 0.1 and 0.8% (Figure 1) ($p > 0.05$).

These results were similar to those reported by Ayad et al. (2019) in the slaughterhouse of Bejaia (Northeast Algeria) where *F. hepatica* was more prevalent in cattle (2.8%) than in sheep (0.1%). These authors also reported a decrease in *F. hepatica* infection prevalence in cattle during their study whereas it remained roughly constant in sheep. Similarly, in Metidja region (north center of Algeria), the infection prevalence in cattle was 2.9% in livers (Chaouadi et al., 2019).

Our results were however lower than those reported by other authors in the same Constantine wilaya: 9.1% in slaughtered cattle and 6.3% in living cattle (Mekroud et al., 2004). The prevalence variability might depend on the ruling set in each slaughterhouse, the number and age of the animals slaughtered, and the precedence of this study in relation with the present one.

In other Algerian areas, the prevalence of *F. hepatica* is higher than that found in Constantine, as in Jijel (Northeastern Algeria) where a similar prevalence was observed in slaughtered cattle (27%) and living cattle (27.3%) (Mekroud et al., 2004). This difference could be explained by the environmental and climatic conditions of grazing areas in that region and by the density of the intermediate host of *F. hepatica*, the snail *Galba truncatula*. In Mitidja Region (north center of Algeria), the overall prevalence of *F. hepatica* infection in slaughtered cattle was estimated at 6.1%. This prevalence varied according to the method used: it was 2.9% following liver inspection for search of adult *F. hepatica* flukes, and 5.5% by detection of *F. hepatica* eggs using microscopic bile examination (Chaouadi et al., 2019). The difference could be due to the low sensitivity of liver inspection as reported by Rapsch et al. (2006) who mentioned that the sensitivity of carcass inspection (63.2%) was lower than that of coproscopy (69.0%), bile examination (93.7%) and antibody ELISA (91.7%). Such low sensitivity of carcass inspection may also have lowered the prevalence of *F. hepatica* infection in the Constantine slaughterhouses.

Prevalence of Echinococcus granulosus infection

The prevalence of CE was significantly higher in cattle (3.3% and 9.7% in livers and lungs, respectively) than in sheep (0.5% and 1.1%, respectively) ($p < 0.001$; Tables I and II). It was also significantly higher in lungs than in livers for both species ($p < 0.001$). CE prevalence for each organ (the examined records did not allow to determine a global CE prevalence for the slaughtered animals) did not vary significantly during the survey period in both sheep and cattle ($p > 0.05$) (Figure 2).

CE reported prevalence in Algeria varied highly, even when various authors studied it in the same region at different periods or in different places in the same region. Kayoueche (2009) thus reported

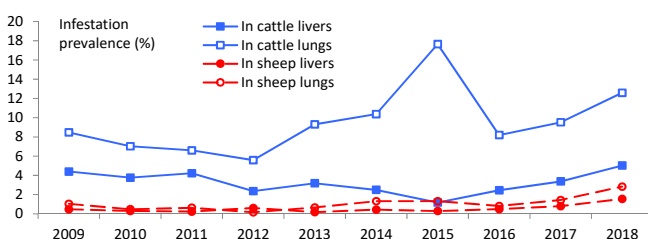


Figure 2: Annual prevalence of cystic echinococcosis according to cyst location in cattle and sheep slaughtered in Constantine slaughterhouses in Algeria (2009-2018) // *Prévalence annuelle du kyste hydatique selon la localisation des kystes chez les bovins et les ovins abattus dans les abattoirs de Constantine en Algérie (2009-2018)*

in Ain Abid and El Khroub, two communes of Constantine, prevalences of 1.3% and 24%, respectively. Some studies obtained higher prevalences than the present ones in slaughterhouses: 13.9% in five northeastern regions of Algeria (Bardonnet et al., 2003). Other studies revealed, on the other hand, lower infection rates. Ayad et al. (2019) in Bejaia (Northeast Algeria) reported a prevalence of 2.2% and 2.5% in sheep and cattle, respectively.

High prevalence of CE was reported in Morocco (Azlaf and Dakkak, 2006) where the global CE infection prevalence rates were 23.0% and 10.6% in cattle and sheep, respectively. The majority of the Moroccan rural areas examined in that study are characterized by the same epidemiological context: poor hygiene and presence of stray dogs in both slaughterhouses and farms. Moreover, health education of the population is inadequate and neglected (Azlaf and Dakkak, 2006; Dakkak, 2010).

What are the reasons explaining these highly variable prevalences? Ayad et al. (2019) suggested several ones, such as the more or less adequate control of dogs' infection and dog density, or variations in agroecology between regions where the environmental conditions may be more or less favorable to the persistence of parasites. Other authors incriminate the diversity of the genotypes of *E. granulosus* (Mellau et al., 2010; Ould Ahmed Salem et al., 2010; Ayad et al., 2019). Moreover, determination of CE prevalence is also influenced by practices in each slaughterhouse, e.g. mandatory or discretionary condemnation and destruction, proportion of inspected animals by veterinarians among the slaughtered animals, awareness of slaughterhouse workers, training of veterinary inspectors.

In Algeria, efforts have been made by the Agricultural Services (Direction des services agricoles) to control CE: awareness campaign, mainly during the Muslim feast of sacrifice of sheep, Eid Al Adha, via booklet distribution during this period; mobilization of veterinarians on the day of Eid to implement seizing of CE infected organs at the slaughterhouses but also in the neighborhoods, where some sheep are slaughtered. However, to date, the prevalence of this parasite in Algeria remains high, maybe because of the persistent presence of wandering dogs. The breeders have however started in recent years to treat their herds against helminths, either on their own or with the help of veterinarians. This practice has become more and more generalized which may explain the decrease in *F. hepatica* infection prevalence.

CONCLUSION

The present study showed that CE and *F. hepatica* induce frequent lesions in both sheep and cattle in the slaughterhouses in Constantine. This could provide useful information on the epidemiological situation of two important parasitic infections in ruminants in Constantine, Northeast Algeria.

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Conflicts of interest

The authors declare that they have no conflict of interest.

Author contributions statement

DG participated in the study design and planning, collected and analyzed data, interpreted results, drafted the first version of the manuscript and critically reviewed the ms. OA participated in study planning, analysis and interpretation of results. MG took part in ms. drafting, analysis and interpretation of results, and critical review of the ms. LB participated in study planning.

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Résumé

Gherroucha D., Ayadi O., Gharbi M., Benhamza L. Infection parasitaire des foies et des poumons chez les bovins et les ovins dans les abattoirs de Constantine, Algérie, de 2009 à 2018

Une étude rétrospective a été réalisée à partir des registres des abattoirs de Constantine, Algérie, sur 145 919 bovins et 345 282 ovins apparemment sains, abattus entre 2009 et 2018. L'objectif était d'estimer la prévalence des deux principales infestations parasitaires qui causent des lésions macroscopiques dans le foie et les poumons : le kyste hydatique (KH) et la fasciolose (infestation par *Fasciola hepatica*). L'examen *post mortem* a consisté en une inspection visuelle, une palpation des poumons et des foies, et une incision systématique des foies, selon les recommandations de la FAO. La prévalence de la fasciolose a été significativement plus élevée chez les bovins (2,7 %) que chez les ovins (0,2 %). Sur cette période de 10 ans, une diminution non significative de la prévalence de la fasciolose a été observée chez les bovins, passant de 4,5 à 2,0 % ($p > 0,05$). La prévalence du KH dans les foies et les poumons a été significativement plus élevée chez les bovins (respectivement 3,3 % et 9,7 %) que chez les ovins (respectivement 0,6 % et 1,1 %). La prévalence du KH a été significativement plus élevée dans les poumons que dans les foies. Ces résultats ont montré l'importance de ces infections parasitaires dans la province de Constantine et ses environs, ce qui impose la mise en place d'un programme de lutte contre ces infestations aussi bien chez les ovins que chez les bovins.

Mots-clés : ovin, bovin, *Fasciola hepatica*, échinococcose, abattoir, morbidité, Algérie

Resumen

Gherroucha D., Ayadi O., Gharbi M., Benhamza L. Infección parasitaria de los hígados y pulmones en bovinos y ovejas en mataderos de Constantina, Argelia, entre 2009 y 2018

Un estudio retrospectivo se llevó a cabo a partir de registros de mataderos de Constantina, Argelia, en 145 919 vacunos y 345 282 ovejas aparentemente sanos, sacrificados entre 2009 y 2018. El objetivo fue el de estimar la prevalencia de las dos infestaciones parasitarias dominantes, causantes de lesiones macroscópicas en el hígado y los pulmones, a saber, equinococosis quística (CE) e infección por *Fasciola hepatica*. El examen *post-mortem* consistió en una inspección visual de los órganos, palpación de los pulmones e hígados, e incisión sistemática de los hígados, llevada a cabo según los procedimientos de la FAO. La prevalencia de la infección por *F. hepatica* fue significativamente más elevada en bovinos (2,7%) que en ovejas (0,2%). Hubo una disminución no significativa de 4,5 a 2,0% ($p > 0,05$) en la prevalencia de *F. hepatica* en el ganado durante el periodo de 10 años. La prevalencia de CE en los hígados y pulmones fue significativamente más elevada en ganado (3,3% y 9,7% respectivamente) que en ovejas (0,6% y 1,1% respectivamente). La prevalencia de CE fue significativamente más elevada en pulmones que en hígados. Estos resultados muestran la importancia de estas infecciones parasitarias en la provincia de Constantina y sus alrededores, lo que requiere una implementación de programas de lucha contra estas infecciones tanto en ovejas como bovinos.

Palabras clave: ovino, ganado bovino, *Fasciola hepatica*, equinococosis, mataderos, morbosidad, Argelia