

## Original paper

# Investigation of flukes (*Fasciola hepatica* and *Paramphistomum* sp.) parasites of cattle in north-eastern Algeria

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**ABSTRACT.** Fasciolosis due to *Fasciola hepatica* is one of the dominant pathologies in Algeria. On the other hand, gastroduodenal paramphistomosis are little studied and little known. Our work consisted of an epidemiological survey in the Souk-Ahras region to investigate these two parasites in cattle. Regarding the epidemiological investigation, it took place in the Souk-Ahras abattoirs, where 530 cattle were inspected for the presence of both parasites. The prevalence of fasciolosis was 12.3%, while the prevalence of paramphistomosis was 7.9% in cattle. Elderly animals were more infected than those under two years of age and females were more infected than males and for both parasites. Therefore, it is important to take into consideration both parasitic diseases and appropriate control measures are strongly recommended to improve cattle productivity.

**Keywords:** cattle, fasciolosis, paramphistomosis, epidemiology, Souk-Ahras, Algeria

## Introduction

Fasciolosis and paramphistomosis are particularly severe helminthoses that often affect ruminants [1,2]. Considered as one of the major parasitic diseases in north-eastern Algeria [2,3], they are mainly caused by the development of *Fasciola hepatica* in the hepatic parenchyma, the bile ducts, and *Paramphistomum* sp. in the gastric tract [1–5].

Alongside *Fasciola gigantica*, the *F. hepatica* flukes are widespread trematodes in temperate countries and tropical highlands [1–6]. Its life cycle involves *Galba truncatula*, an amphibious gastropod mollusc, as an intermediate host, and the liver and bile ducts of a ruminant as definitive location and host [7]. Humans are also involved but are considered accidental hosts [8]. On the other side, paramphistomosis is digestive helminthosis due to the presence in the abomasum and the small intestine of immature forms of trematodes while the

adult pathogenic forms are living in the rumen [1–10].

*F. hepatica* and the gastroduodenal parasite *Paramphistomum* sp. are sharing the same intermediate host (*G. truncatula*) which makes the epidemiology of diseases caused by these two parasites quite close to each other [7–11]. Often neglected and underestimated by breeders because of their subclinical manifestation, fasciolosis and paramphistomosis are responsible in Algeria for severe economic losses, and several zootechnical and sanitary effects [5–11].

Anthelmintic treatments remain the most used way against these parasites. However, the massive and uncontrolled use of these products has unfortunately led to the installation of a phenomenon of chemoresistance as it has been demonstrated, in Algeria, for the Albendazole specialties [12].

The Souk-Ahras region climate and the large rural population devoted to cattle breeding play a



Figure 1. Presentation of the study area

preponderant role in the accomplishment of the life cycles of these trematodes. However, the lack of data in this region about these two parasites and their intermediate host has led us to conduct an epidemiological investigation in the slaughterhouse in order to update the knowledge on these two flukes.

## Materials and Methods

### Study area

This study was carried out in the extreme northeastern Algeria, in the Souk-Ahras region (Fig. 1). This region is geographically divided into three different zones: firstly, the northern zone is

Table 1. Origin, sex and age of slaughtered cattle at the slaughterhouse in the Souk-Ahras region

Origin	Number of cattle	Sex		Age		
		Male	Female	1–3 years	3–5 years	Over 5 years
Merahna	61	57	4	57	0	4
Ouillen	225	219	6	217	1	7
Henancha	28	13	15	12	1	15
Mechrouha	41	8	33	8	2	31
Souk-Ahras	30	16	14	15	2	13
Taoura	71	49	22	45	4	22
Ouled Driss	46	20	26	18	4	24
Tiffech	26	12	14	12	2	12
Khemissa	2	0	2	0	1	1
Total	530	394	136	384	17	129

Table 2. Prevalence of fasciolosis and paramphistomosis in cattle slaughtered at the Souk-Ahras slaughterhouse

Pathologies	Infected cattle	Prevalence (%)
Fasciolosis	65	12.26
Paramphistomosis	42	7.9
Associated cases	17	3.2

characterized primarily by mountains, cold-dry climate, heavy rainfall exceeding 700 mm/year, with an extensive cattle breeding; then the median zone consists of plains with a subhumid climate, a pluviometry inferior to 700 mm/year, and a semi-intensive cattle breeding. Finally, the south zone is represented by large areas with a semi-arid hot-dry climate and low rainfall levels i.e., < 400 mm/year, it is known for sheep and goat farming [13].

#### Study animals

The study was conducted in the slaughterhouse in the Souk-Ahras region. All sacrificed cattle come from neighbouring localities; mainly the northern and median zones. To evaluate the importance of parasitism, three epidemiological factors were gathered: the origin, the sex, and the age of each slaughtered animal. To do so, three age categories were defined: young (1–3 years), intermediate (3–5 years) and over five years old.

Of the 530 slaughtered cattle, 225 (42.5%) were from Ouillen, 71 (13.4%) from Taoura, 61 (11.5%) from Merahna, 46 (8.7%) from Ouled Driss, 30 (5.6%) from Souk-Ahras, 26 (4.9%) of Tiffech and 2 (0.4%) were from Khemissa.

Males and young's (1–3 years) constituted the dominant population with 394 (74.3%) and 384 (72.4%), respectively. They were followed by animals over five years old 129 (24.3%) (Tab. 1).

The livers of the slaughtered animals were inspected following a rigorous protocol that started by reporting any changes of shape, colour, volume, or consistency of the inspected livers. Then, two incisions were realized: the first incision was long and shallow; it was realized at the junction of the two main lobes of the liver and near the bifurcation of the biliary trunk while the second was short and shallow and made at the base of Spiguel lobe. The *F. hepatica* worms were extracted by exerting manual pressure on the bile ducts (Fig. 2).

The rumen and reticulum of these animals were also inspected (Fig. 3). An opening was performed along the great curvature, then the ruminal content



Figure 2. *Fasciola hepatica* infection



Figure 3. Adult *Paramphistomum* sp. attached to the reticulum mucosa

was emptied by returning it.

It was finally rinsed with fresh water and the presence of adult *Paramphistomum* sp. attached to the mucosa was explored [2].

#### Statistical analysis

Statistical analyses were carried out using the SPSS v24.0 software (IBM SPSS Statistics for Windows, Version 24.0) and the Pearson's chi-squared " $\chi^2$ " test was used to compare the overall prevalence of *F. hepatica* and *Paramphistomum* sp. according to the season, the region, the sex, and age of the cattle.

Table 3. Standards for the estimation of the parasitic intensity

Parasites Intensity	Low	Medium	Hight
<i>Fasciola hepatica</i>	≤ 20	20–50	≥ 50
<i>Paramphistomum</i> sp.	≤ 100	100–1000	≥ 1000

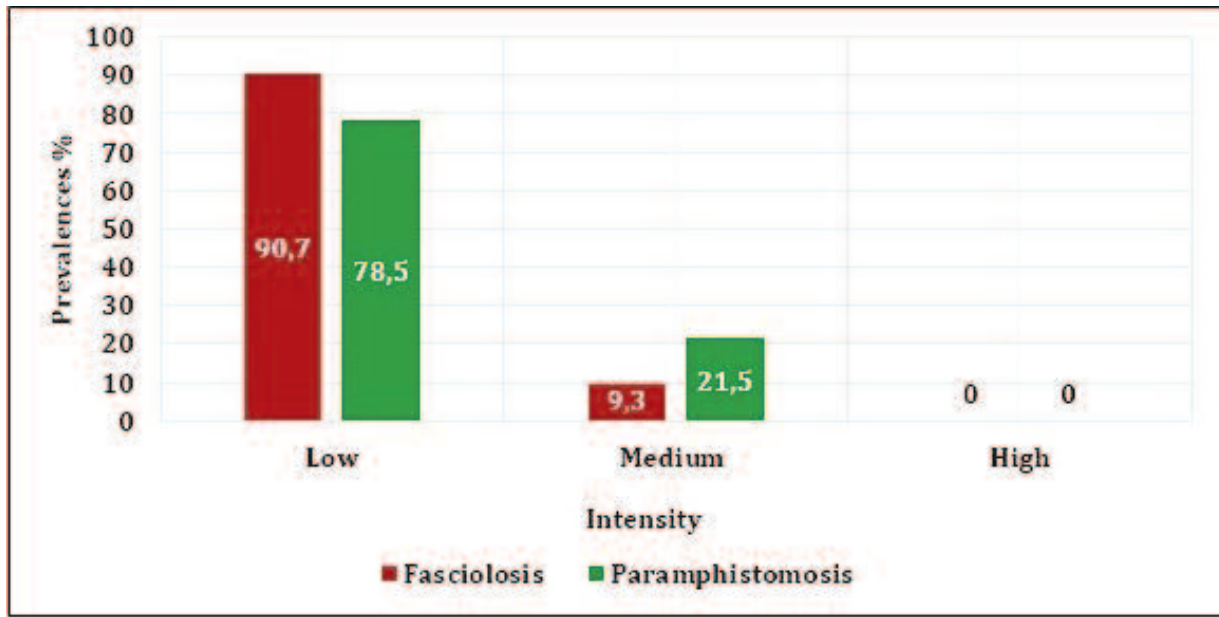


Figure 4. The intensity of fasciolosis and paramphistomosis in cattle

**Results**

*Prevalence and intensity of infection*

Of the 530 slaughtered cattle, 65 (12.3%) were infected with *F. hepatica* while 42 (7.9%) with *Paramphistomum* sp. (Tab. 2). These two trematodes were associated with 3.2% of the cases and evolve with low and medium intensities.

For the two trematodes, the infection intensity was estimated by determining the number of observed parasites (Tab. 3; Fig. 4).

*Receptivity factors*

Seasonal follow-up of the two parasitic diseases (Fig. 5) indicates that fasciolosis infection rates vary between 12% in winter and 14.4% in summer while

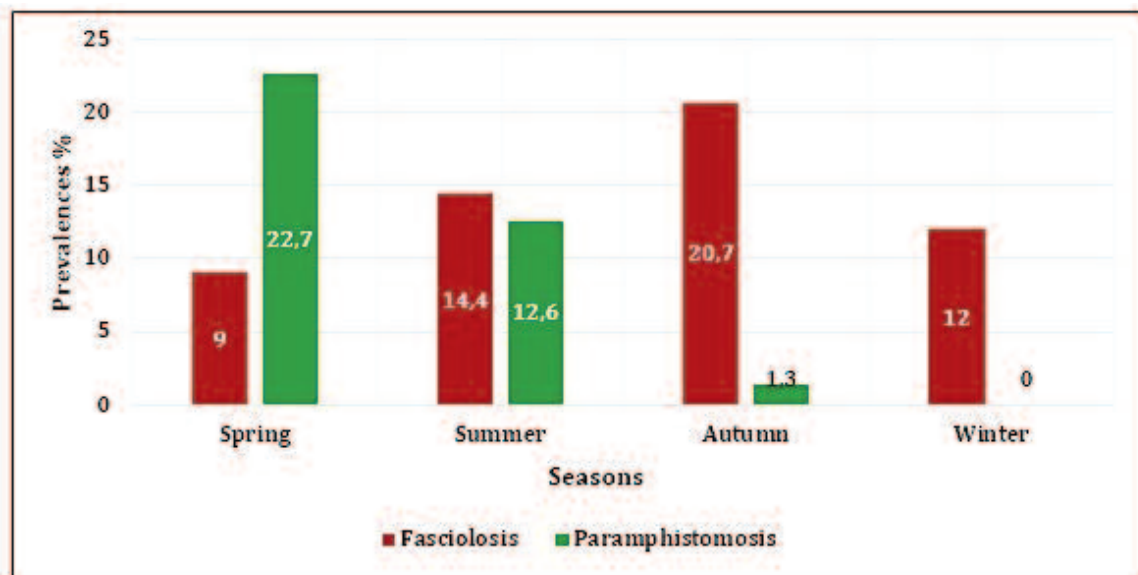


Figure 5. Prevalence of fasciolosis and paramphistomosis according to the seasons

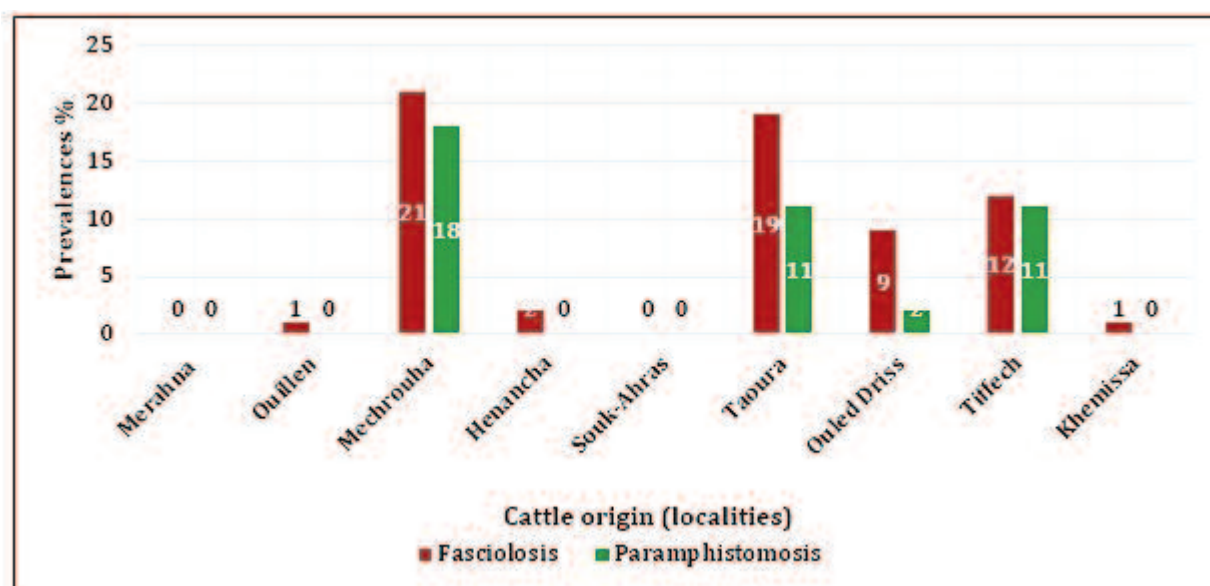


Figure 6. Prevalence of fasciolosis and paramphistomosis according to cattle origin

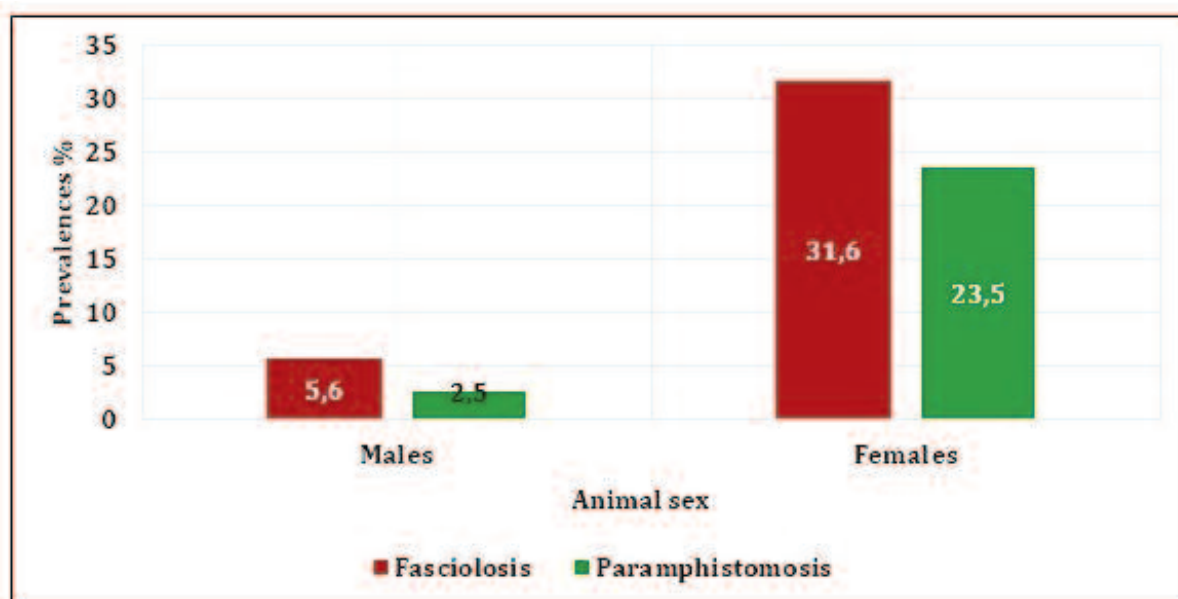


Figure 7. Prevalence of fasciolosis and paramphistomosis according to cattle sex

for paramphistomosis, the highest rates were observed in spring (22.7%) and summer with 12.6%. Nevertheless, no paramphistomosis infection cases were reported in winter.

Monitoring the overall prevalences depending on the animal's origins (Fig. 6) showed that most of fasciolosis (21%) and paramphistomosis (18%) cases were observed in the Mechroha region. Nonetheless, low prevalences were observed in Ouillene (1%) and Khemissa (1%) regions for fasciolosis and Ouled Driss (2%) for paramphistomosis. These results allow us to define a statistically significant ( $\chi^2$  test,  $\rho=0.001$ ) influence of the region on infection rates.

Females were more parasitized than males with

respectively 31.6% for fasciolosis and 23.5% for paramphistomosis (Fig. 7).

For both trematodes, cattle aged between three and five years were most frequently infected with *F. hepatica* (35.3%) and *Paramphistomum* sp. (29.4%) (Fig. 8). However, the lowest prevalence rates (5.7% and 2.1% respectively) were recorded for cattle of 1–3 years category. Likewise, the sex and age of the animals interfere significantly ( $\chi^2$  test,  $\rho=0.001$ ) with the infection rates.

Monitoring the monthly kinetics of bovine fasciolosis showed an annual activity, with a high prevalence in September (26.3%) and a low rate in November (Fig. 9). On the other hand, bovine

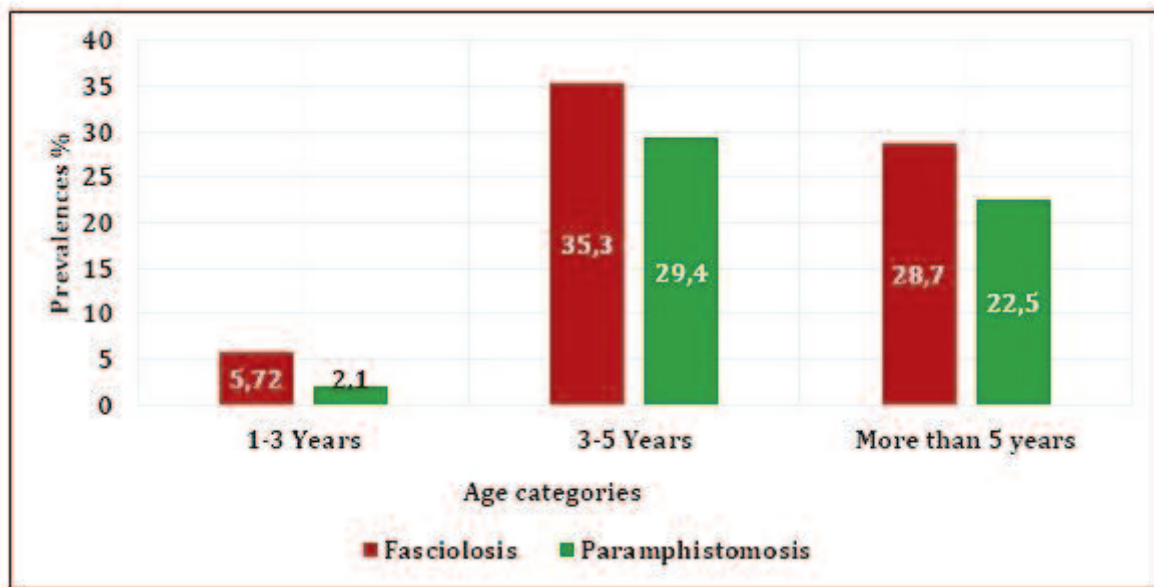


Figure 8. Prevalence of fasciolosis and paramphistomosis according to cattle age categories

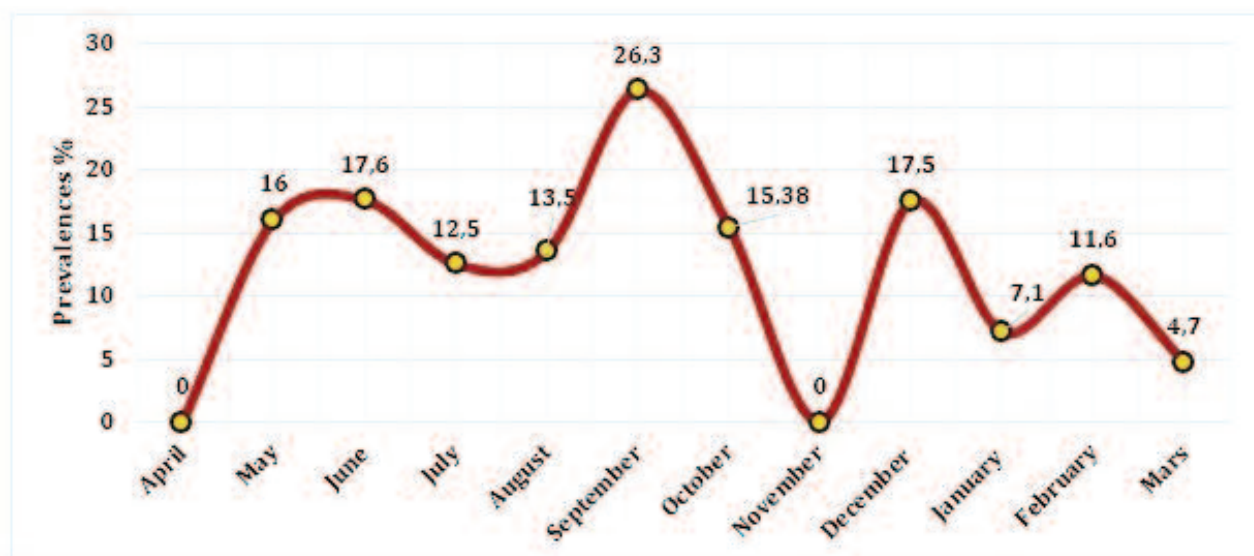


Figure 9. Monthly prevalence of fasciolosis in cattle

paramphistomosis monthly prevalences evolve between April and August with stable infection rates (5%). However, after this period, the prevalences decline, and no cases were encountered until March (3%) (Fig. 10).

The influence of the period on prevalences was statistically significant for paramphistomosis ( $\chi^2$  test,  $\rho=0.222$ ) while for fasciolosis there was no relation between months and prevalences ( $\chi^2$  test,  $\rho=0.002$ ).

## Discussion

Fasciolosis prevalence in the Souk-Ahras region (12.3%) is considered as low when compared to

prevalences reported in several Algerian regions such as El Tarf where the prevalence was 52.4% in 2012 [2] and 26.7% in 2018 [11]; and Jijel with 27.2% in 2004. However, in a recent study conducted in several slaughterhouses of Bejaïa region, the prevalences were very low (2.8%) [3].

Not far from Algeria, the infection was reported in cattle in other Maghreb countries such as Morocco (10.4%), and Tunisia (12.6%) [14,15]. Nevertheless, various surveys on fasciolosis were conducted in Africa with prevalences varying from 12.3% to 30.4% in Egypt [16,17], 7.1% to 15.3% in Nigeria [18,19], and 37.1% in Zimbabwe [20].

Regarding paramphistomosis, the prevalences were also considered as low (7.9%) when compared

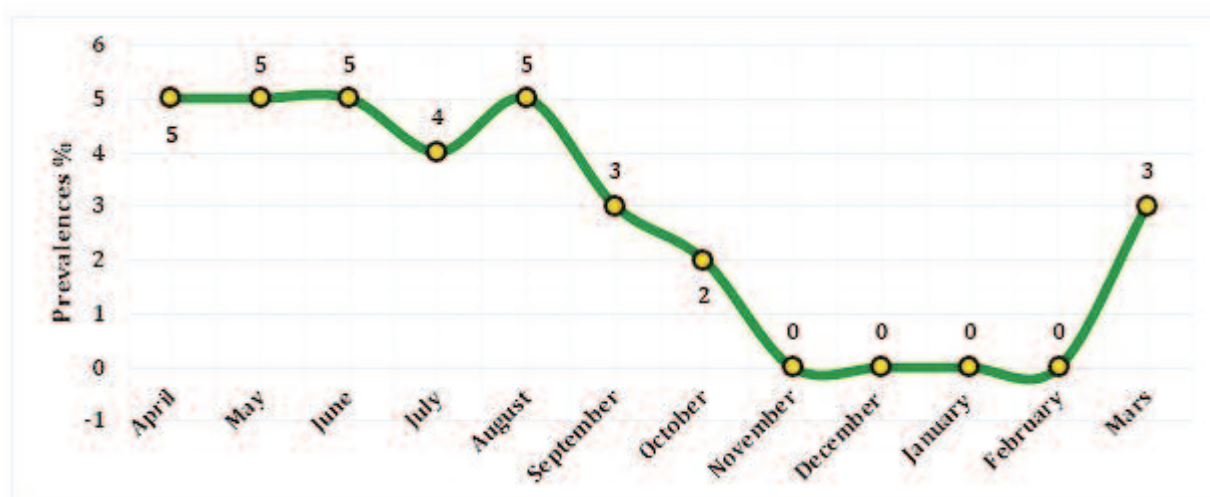


Figure 10. Monthly prevalence of paramphistomosis in cattle

to those observed in El Tarf (19.3%) and Jijel (14.5% and 14.6%) [2–5]. Nevertheless, the results presented in this study were close or lower to those found in other countries such as France (20%) [21], Zimbabwe (27%) [22], Egypt (47.1%) [23], and Ethiopia (51.8%) [24].

Through these prevalences, great variability in infection rates can be observed. This variability could be due to several factors, such as the breeding environment of the animals, their age, the biotopes of the snails, the climate, and even the lack of pharmaceutical products used against these trematodes.

The disparity of the results recorded in our region and those of El Tarf and Jijel can mainly be explained by the fact that the last two regions are temperate wetlands with agro-climatic and ecological characteristics favoring the development of *G. truncatula*.

During our investigation, both trematodes evolved with low intensities. Our results in terms of paramphistomosis corroborate those previously reported where 56.2% (Jijel) and 53.5% (Mila) of examined ruminants were infected with less than 100 *Paramphistomum* sp. [25]. Similar findings were reported in France and Ireland [21–26] while a parasitic load of  $270.46 \pm 471.947$  was noticed in Ethiopia [27].

These differences in the intensity of infection can be related to several factors such as the abundance of favourable biotopes for *G. truncatula*, the poor health status of the animals, and the application of treatments.

Through the seasonal evolution of fasciolosis, we revealed two infection peaks: the first one

occurred in summer (14.4%) while the second in winter (12%). For paramphistomosis, we observed only one peak in spring (22.7%) and the absence of affected animals in winter. In this context, the risk periods for fasciolosis have been already determined in Algeria and precisely the Jijel region [28]. The authors studied *G. truncatula* main characteristics and monitored their population dynamics. The study showed the presence of two annual generations of molluscs (from October to December and from April to May) therefore two cycles of *F. hepatica* in molluscs.

Besides, high summer prevalences of fasciolosis were already highlighted in studies conducted in Ethiopia and Nigeria. According to these research works, these results may be related to a long prepatent period [29,30].

On the other hand, this investigation allowed us to determine two areas where the cattle are more affected by fasciolosis and paramphistomosis, namely the Northern area and the middle one. This zone-effect phenomenon could be explained by the richness of these two areas in water resources (two large dams, two small dams, and four large hill reservoirs) and their sub-humid climate, thus, favorable biotopes for the development of snails.

In our study, we have highlighted a statistically significant relationship between sex and the infection rate of cattle. Moreover, previous studies have already shown that females were statistically more infected than males [21–32]; this could be related to the immune status of the females during pregnancy and lactation where they could be more prone to infection [33,34].

Moreover, young males of the Souk-Ahras

region were kept in the stable, especially in the region of Ouillene which is known for the fattening and the breeding of bull calves. In this region, females are put to grass more quickly (without any prophylactic plan). Consequently, the males are slaughtered in good health, while the females are usually sent to the slaughterhouse for several health conditions.

On the other side, our findings regarding the effect of age on the receptivity of cattle are in line with previous reports that consider aged cattle to be the main reservoirs of helminthic diseases [35,36]. Indeed, it has been already highlighted that the seizure of parasitized livers increases with advancing age. Previous studies have linked that to the predisposition of aged cattle to health problems and mainly parasitic infections by the weakening of their immune system. However, other reports stated that young cattle (< 2 years old) are more prone to infection [37] and that animals will become immunized and less exposed to infections when aged [38,39].

Regarding paramphistomosis, our results are in line with previous reports which indicate that old cattle are more affected [5–27], mainly due to the weakening of the immune system of the animal [40].

Based on the results of this study, it is concluded that cattle are mostly infected with trematodes parasites. It can be concluded that, despite the limited use of inspection data from slaughterhouses, the information collected can be very useful for a better understanding of the epidemiological data of the parasites studied, in view of a better management of the parasitoses caused.

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