

A survey of *Haemonchus contortus* parasite of sheep from Gharb plain, Morocco

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ABSTRACT

The study was designed to determine the prevalence of *Haemonchus contortus*, intestinal helminthes parasite of sheep in the Gharb plain (Morocco).

A total of 1154 sheep were randomly selected from farms, pastures and abattoirs, the samples were examined using a flotation techniques for determination the eggs of *Haemonchus contortus*. In order to identify *Haemonchus contortus* among the different gastrointestinal strongyles present in mixed infections, a faecal culture was carried out for each farm and pasture. This study was carried between November 2016 and October 2017. The data were analysed with respect to sex, age, season and body condition of sheep examined. Out of (1154) samples examined, (23.92%) harbored *H. contortus*. Prevalence among female (30.98%) was higher than that of the males (15.63%), there was significant difference between prevalence of infection and sex ($P < 0.05$). Based on age group, prevalence of haemonchosis was 6.25% and 43.22% in young and aged animals respectively showing the statistical significance ($P < 0.05$). Seasonal variation was recorded throughout the year and was highest during spring (36.36%) and autumn (32.37%) against a low rate of 2.7% in the summer with significance difference ($P < 0.05$). Regarding the relationship between *Haemonchosis contortus* and body condition, maximum prevalence (80.83%) was recorded in animals with poor body condition, followed by those with moderate body condition (34.26%), while the lowest infestation rate (6.88%) is noted in animals with good body.

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1. Introduction

The distribution of sheep is global, with high numbers, showing the ability to adapt to various climates and universal interest, it also has a social and cultural very important role in some societies. It is used to accumulate capital and put it in reserve.

In Morocco sheep farming is a reserve of varied and adapted genotypes. It values a natural plant source, free and of good nutritional value that few other animals can exploit. It plays a key role in Moroccan agriculture, in comparison to other ruminant, sheep are produced in every region regardless of agro-ecological and socio-economic conditions. Is economically and socially important in the country. It provides about 35% of the red meat production. This specie contributes to the celebration of the Abraham ceremony, as >4 million heads are sacrificed each year (Boujenane, 2006). However, this type of extensive traditional breeding, which is almost complete in its entirety, suffers from a number of constraints related to its own mode of conduct and which may harm their development, among these constraints, infestations by gastrointestinal nematodes. A literature review of last decade reveals many species of parasites in sheep included: *Haemonchus contortus* (H.c), *Oesophagostomum*, *Ostertagia*, *Nematodirus*, *Trichuris*, *Moniezia* and *Fasciola* ..., the most important of them is *H. contortus* (H.c), responsible for the parasitic disease: haemonchosis.

H. contortus an important, voracious blood sucking parasite of small ruminants found in abomasum, cause major production losses world-wide and heavy burden of this blood feeding parasite causes anemia, diarrhoea, loss of weight, oedema, recumbency, severe debility and ultimately death (Ejlertsen et al., 2006; Squires et al., 2011; Nabi et al., 2014). *H. contortus* sucks about 0.05 mL of blood per day by ingestion or liberation from lesions (Qamar and Maqbool, 2012).

Haemonchosis is widespread wherever sheep and goats are raised, but the greatest economic losses occur in temperate and tropical regions (Ijaz et al., 2008; Torres-Acosta and Hoste, 2008; Calvete et al., 2014). The disease has also found in the colder climates and recently been found as far north as the Arctic Circle (Fentahun and Luke, 2012).

There are many risk factors that contribute to the occurrence of haemonchosis, such as, host and environment (agro-ecological conditions, husbandry practices, deworming intervals and pasture management) (Ratanapob et al., 2012). Other risk factors such as host species, sex of the animal, age, body condition and race/genotype (Badaso and Addis, 2015). Parasite species and the intensity of the worm population, have an effect on the development of gastrointestinal parasitic infections (Tariq et al., 2008).

This article investigates the prevalence of *H. contortus* of sheep raised in Gharb plain according to the risk factors as age of animals, sex, season and body condition.

2. Materials and methods

2.1. Study area

The study was carried out in Gharb plain, which is located in North West of Morocco in the Mediterranean zone. This area profits from a Mediterranean climate, characterized by mild, moderate and rainy in winter and wet and moderate in summer. The location of the region on the Atlantic Ocean confers abundant precipitations to him, which largely exceed the national average. These precipitations are around 500 mm a year at Kenitra (province of the Gharb area) in the last 20 years.

The inequalities of the relief make that the climate presents important local variations and is characterized by an apparent variability (the minimal temperature is of 4 °C and maximal of 40 °C). In summer, the atmosphere is heated appreciably, the more frequent maximum temperatures in July vary between 16 °C and 26 °C. Peaks of 38 °C with 40 °C could be recorded a few days a year, but their frequency remains exceptional.

2.2. Study animals and sampling methods

The present study was conducted from November 2016 to October 2017 to estimate the prevalence of *H. contortus* in sheep according to some parameters as age, sex, season and body condition of host.

A total of 1154 sheeps were randomly selected from farms, pastures and abattoirs and examined for eggs and worms of *H. contortus*, (faecal examination: 857; abomasum examination: 297). Faecal samples collected were examined by the modified McMaster technique using saturated solution of sodium chloride. The worms were collected in normal saline and identified based on the characteristics given by Soulsby (1982). The sexes, age and body condition were included in this study to demonstrate the role of host factors in the prevalence of Haemonchosis infection. Collection of data was repeated monthly, with the aim to include more and more flocks in the study and to demonstrate the seasonal differences in the prevalence and level of infection. The body condition score was determined and grouped as good, medium and bad.

2.3. Data analysis

Microsoft excel software was used to store the data and analysis of simple descriptive statistics. Computation of descriptive statistics was conducted using IBM-SPSS version 24.0. Confidence level was held at 95% and statistical analysis for the difference in prevalence of *H. contortus* among risk factors are considered significant when the *P*-value was <0.05.

3. Results

During the course of this study, a total of 1154 (531 males and 623 females) sheep were screened using faecal and postmortem examination. Out of these, 276 were found infected by *H. contortus* (*H.c*) (faecal infestation: 209; abomasum infestation: 67) indicating an overall prevalence of 23.92%. The distribution of *H.c* by sex indicated an overall prevalence in females of 30.98% (faecal prevalence: 31.81%; abomasum prevalence: 28.66%) and 15.63% in males (faecal prevalence: 15.83%; abomasum prevalence: 15.04%) ($P < 5\%$) (Table 1).

The prevalence of parasite according to age, showed in (Table 2), reveal a lower percentage in young sheep (6.52%) than the old (43.32%) ($P = 0.000$). The study of the distribution of *H. contortus* infection according to the seasons revealed a high rate of 36.36% and 32.37% in spring and autumn respectively against a low rate of 2.7% in summer ($P = 0.000$) (Table 3). Regarding the relationship between haemonchosis and body condition, the prevalence is 6.88% in healthy sheep, 34.26% in moderate body condition, and 80.83% for animals in poor condition with statistical significance variation ($P = 0.000$) (Fig. 1).

4. Discussion

4.1. Overall prevalence of *H. contortus* infection in sheep

Haemonchosis is a serious health problem that leads to a decline in production due to high morbidity, mortality and cost of treatment and control measures (Qamar and Maqbool, 2012). Examinations of the 1154 (857 faecal and 297 abomasum examinations) for *H. contortus* resulted in an infestation rate of 23.92% (276/1154) (faecal examination revealed 209 animals infected, examination of abomasum indicated 67 infected animals). The prevalence of ovine haemonchosis in our study is much lower than the prevalence in other studies in different countries such as Sudan 36.4% (Mubarak, 2013), Ethiopia (Sissay, 2007; Abunna et al., 2009; Dagnachew et al., 2011), in Pakistan (Tasawar et al., 2010; Asif et al., 2008; Raza et al., 2009), and in Benin (Attindehou et al., 2012). However, our prevalence is much higher than that found in Iran 9.3% and Egypt 7.9% (Sultan et al., 2010). This difference in prevalence may be due to cold winters and hot summers that destroy the parasite.

4.2. Variation of haemonchosis according to sex of sheep

In the present investigation, statistical analysis of the data on the prevalence of haemonchosis between sexes showed that there was significant difference ($P < 0.05$) between male (15.63%) and female (30.984%). It is assumed that is a determinant factor influencing prevalence of haemonchosis and females are more susceptible to parasitism due to reproductive stress and decreased immune status (Urquhart et al., 1996). This is coincided with the results of different countries in Pakistan (Raza et al., 2009), in Ethiopia (Dagnachew et al., 2011; Moges et al., 2017), and in Iran (Tehrani et al., 2012), and disagreement with previous findings which were reported in Ethiopia by Tewodros and Girja (2012) as 80.9% and 77.1% in males and females respectively in Gonder town, Zelalem et al. (2014) who reported 73.22% and 64.71% in male and females respectively in and around Finoteselam in Amhara region and Tibeso and Mekonnen (2015) also reported 66.0% in female and 59.7% in male in ArsiNegelle in Oromo region.

4.3. Variation of haemonchosis according to age of sheep

The results obtained showed that *H. contortus* infection is age-related ($P < 0.05$) and the highest rate is observed in animals less than one year old (43.22%). The infection is due to the low resistance of these animals that have not been exposed to infection earlier as exposure to nematode infection increases, the immune system of the host animals develops specifically against these parasites and resistance to age is acquired. Therefore, the low level of haemonchosis reported in adult animals, 6.52 in animals over 4 years of age, is due to the development of significant immunity over time. These results of the effect of host age on the prevalence of *H. contortus* infection are consistent with those found by Sissay (2007) in Ethiopia, Tariq et al. (2008) in India, in

Table 1
Relationship between sex and *H. contortus* in sheep in Gharb area, Morocco.

Sex	Faecal examination				Abomasum examination				Total of animals examined	Overall prevalence %
	Examined	Infected	Prevalence (%)	<i>P</i> value	Examined	Infected	Prevalence (%)	<i>P</i> value		
Male	398	63	15.83	0.000 (<5%)	133	20	15.04	0.02 (<5%)	531	15.63
Female	459	146	31.81		164	47	28.66		623	30.98
Total	857	209	24.39		297	67	22.56		1154	23.92

Overall $\chi^2 = 23.10$; overall *P*-value = 0.0000.

Table 2Relationship between age and *H. contortus* in sheep in Gharb area, Morocco.

Age	Faecal examination				Abomasum examination				Total of animals examined	Overall prevalence %
	Examined	Infected	Prevalence (%)	P value	Examined	Infected	Prevalence (%)	P value		
8 months to 1 year	170	11	6.47	0.0000 (<5%)	60	4	6.67	0.004 (<5%)	230	6.52
1 to 2 years	151	17	11.26		51	5	9.8		202	10.89
2 to 3 years	178	40	22.47		60	12	20		238	21.85
3 to 4 years	181	64	35.36		67	21	31.34		248	34.27
>4 years	177	77	43.5		59	25	42.37		236	43.22
Total	857	209	24.39		297	67	22.56		1154	23.92%

Overall $\chi^2 = 74.5$; overall P -value = 0.0000.

Pakistan by Qamar et al. (2009), and Dagnachew et al. (2011), while disagreeing with the findings in Pakistan by Tasawar et al. (2010) and Sudan by Mubarak et al. (2017).

4.4. Variation of haemonchosis according to season of sheep

The seasonal survey showed that the highest rates of infection were observed in spring (36.36%) and in autumn 32.37% and the lowest rate in summer (2.73%), this can be explained by the characteristics of the climate in north-western Morocco which is characterized by a favorable temperature and rainfall ($T = 18.5^\circ\text{C}$ in spring, 17.5°C in autumn, mean annual rainfall = 570 mm) ensuring the development and survival of pre-parasitic stages and leads to an increased availability of infectious larvae. In contrast, summer is a low-risk season for infestation due to summer heat and lack of moisture leading to the destruction of eggs and larvae. It is only in autumn and at the first rains that infestations on pastures resume (Cabaret, 1983). These results are similar to those found in Algeria, by Bentounsi and Cabaret (2013) who stated that the mild or cool semi-arid climate is the most favorable for protostrongles infestation.

4.5. Variation of haemonchosis according to the body condition of sheep

The relationship between body condition and haemonchosis in sheep was recorded with a statistically significant difference ($P = 0.000$) between animals with poor, moderate and good status, which means that these animals do not have the same sensitivity to the haemonchosis. In fact, animals in poor condition show a high rate of infection (75.83%) followed by those with a moderate body condition (33.25%) while healthy sheep are less infected (8.44%). Results similar to this study have been reported by Nagasi et al. (2012), Moges and Hebtom (2017), Mesele et al. (2014) and Gonfa et al. (2013) in Ethiopia. This difference in the infestation rate can be explained by the fact that animals in bad body condition have low immunity against parasitism.

5. Conclusion

This study showed that prevalence of *H. contortus* a major problem in the study areas and could be responsible for the loss of production and mortality, in contrast, the prevalence of haemonchosis is mostly associated with the epidemiological factors such as origin of the animals and host factors such as sex, age and body condition. Climatic factors such as precipitation and temperature, can act in favor of increasing this prevalence which needs great attention when designing the control programs of the parasite.

Table 3Seasonal dynamics of *Haemonchus contortus* infections in sheep in Gharb area, Morocco.

Season	Faecal examination				Abomasum examination				Total of animals examined	Overall prevalence %
	Examined	Infected	Prevalence (%)	P value	Examined	Infected	Prevalence (%)	P value		
Winter	224	50	22.32		78	17	21.79		302	22.32
Spring	209	76	36.36		82	27	32.93		291	36.36
Autumn	241	78	32.37	0.000 (<5%)	77	21	27.27	0.004 (<5%)	318	32.37
Summer	183	5	2.73		60	2	3.33		243	2.73
Total	857	209	24.39		297	67	22.56		1154	23.92

Overall $\chi^2 = 61.13$; overall P -value = 0.0000.

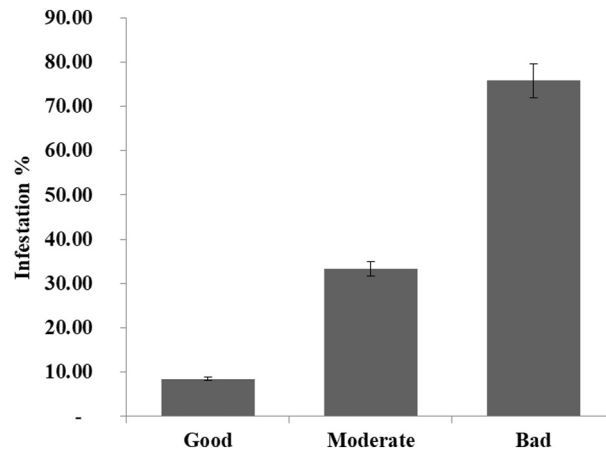


Fig. 1. Relationship between body condition and *H. contortus* in sheep in Gharb area, Morocco.

Conflict of interest

The authors declare that they have no financial and personal relationships with other people or organizations that can inappropriately influence their work and there are no professional or other personal interests of any nature or kind in any product service, and/or company that could be construed as influencing the position presented in, or the review of, this paper.

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