



# Prevalence of Rabbit Coccidia in Medea Province, Algeria

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## ABSTRACT

Coccidiosis has an economic impact for poultry and livestock. The current study examined the prevalence of *Eimeria* infections in domestic rabbits in Medea province, North of Algeria. A total of 414 faecal samples were collected from 50 farms in six regions of the province. Each faecal sample was subjected to oocyst counting and isolation. The *Eimeria* species from samples containing isolated and sporulated oocysts were morphologically identified microscopically. The overall prevalence of coccidial infections was 47.6% (197/414). Weaners had the highest prevalence (77%, 77/100,  $p < 0.0001$ ), followed by growing rabbits (46.8%, 30/64) and the adult rabbits showed the lowest prevalence (36 %, 18/50). In breeding rabbits, females were more infected with a prevalence of 40% ( $p < 0.0001$ ). Eleven rabbit *Eimeria*'s species were present and identified from oocyst positive samples. *Eimeria magna* and *Eimeria media* were the most prevalent species (47.6% and 47.3%). Sulfonamides showed a better protection against rabbit coccidiosis than colistin and trimethoprim association ( $p < 0.0001$ , prevalence of 23.3% vs. 65.3% respectively). These results indicated that the prevalence of coccidiosis is high among the rabbit population in Medea province, North of Algeria. As a conclusion, it seems that the epidemiological situation of rabbit coccidiosis in Medea province must be taken into consideration in order to minimize the economic losses caused by this parasitosis.

**Key words:** *Eimeria*, *Oryctolagus cuniculus*, Rabbit, Sulfonamides

## INTRODUCTION

Coccidiosis is the major parasitosis in poultry and other domestic animals, including rabbits: *Oryctolagus cuniculus* (Pakandl, 2009; Geru et al., 2016). It is one of the most important infectious causes of digestive disorders in rabbits (Pakandl, 2009; Geru et al., 2016). This disease is caused by intercellular protozoa parasites of the genus *Eimeria* and can be responsible for significant mortality in domestic rabbits (Pakandl, 2009). The symptoms of the disease include anorexia, diarrhea, body weight loss, poor feed conversion and even death to weaning rabbits (Pakandl, 2009). Eleven distinct *Eimeria* species have been identified in rabbits. Among these species, ten colonise the intestinal tract, invading and destroying intestinal cells, and causing anaemia, electrolyte imbalance and poor absorption of nutrients (Pakandl, 2009). *Eimeria stiedae* infects the biliary ducts of the liver. Hepatic coccidiosis is most often subclinical, but it can be the cause of poor feed conversion (Al-Mathal, 2008; Pakandl, 2009). All domesticated rabbit breeds can be infected by coccidia, especially the younger animals between one and four months of age (Drouet-Viard et al., 1997a; González-Redondo et al., 2008; Bachene et al., 2014; Bachene et al., 2018). The identification of these coccidia is based on the morphological characteristics of the oocysts and the sporulation time (Coudert et al., 1995; Pakandl et al., 2008). The site of infection and clinical signs can also guide the identification of coccidian species (Pakandl et al., 2008). In Algeria, the epidemiological situation of rabbit coccidiosis is almost unknown, Henneb and Aissi (2013) reported the prevalence of coccidia in Eastern Algeria rabbit breeding: *Eimeria magna* (43%), *Eimeria stiedae* (23%), *Eimeria media* (19%), *Eimeria perforans* (9%), *Eimeria exigua* (3%) and *Eimeria coecicola* (3%) and Maziz-Bettahar et al. (2018) reported the prevalence of rabbit coccidial infection in three regions in the north of Algeria: *Eimeria magna* (42.5%), *Eimeria media* (17.6%) and *Eimeria irrsidua* (14.9%).

The present study was undertaken in Medea, a Northern agricultural province of Algeria, first, to investigate the natural prevalence of coccidial infections in different rabbit farms according to age, sex as well as chemoprevention, and second, to identify *Eimeria* species present in these farms.

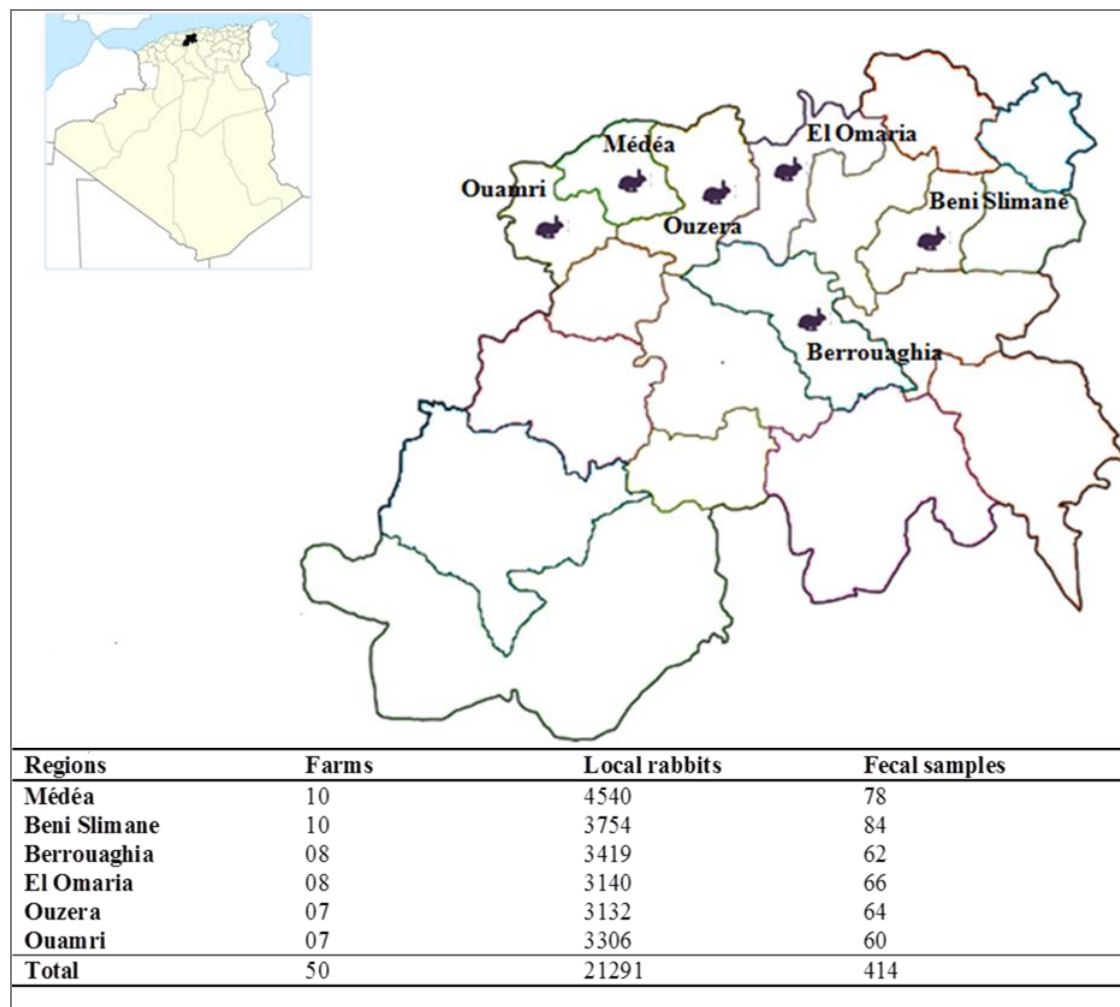
## MATERIALS AND METHODS

### Ethical approval

This work was approved by the scientific council of the Higher National Veterinary School of Algiers, Algeria.

### Study area and selection of rabbitories

The study focused on the rabbit populations in Medea province, a Northern agricultural province of Algeria (Figure 1). This province is located 36.26 latitude, 2.75 longitude and 910 meters above sea level. It has an average annual temperature of 14.4 °C and an average annual rainfall of 736 mm. A total of 414 faecal samples were collected randomly (random numbers table method) from apparently healthy animals of 50 rabbit breeding farms of six regions in this province (Figure 1). Faeces were collected from 21291 rabbits in order to test the presence of oocysts. These rabbits included 15923 weaners (1 to 3 months old), 782 growing rabbits (3 to 6 months old), 502 adult rabbits (older than 6 months) and 4084 breeding rabbits including 585 males and 3499 does.



**Figure 1.** A map of Medea's province, Algeria showing the selected regions and the number of farms of local rabbits breed and fecal samples

### Fecal sampling and parasitological analysis

From each class (weaners /growing/ adults/ breeding males/ breeding females), 500 g of fresh faecal pellets were collected as one sample. After homogenization, 300g of each sample were mixed in 1500 ml of water, and then 40g of the mixture were put into 60 ml of saturated magnesium sulfate ( $MgSO_4$ ) solution (Coudert et al., 1995). The suspension was then emptied into a modified McMaster chamber to check the oocysts, and the Oocyst Per Gram (OPG) was calculated to estimate the degree of infection (Coudert et al., 1995). The limitation of detection value was set as 200 oocysts per gram faecal sample. Purified oocysts were sporulated in a shaker and diluted into a 2.5 % potassium dichromate solution at 28 °C for seven days to ensure good aeration. Concentrated oocysts in each sample were identified based on their sizes and morphological characteristics using a microscope equipped with a camera connected to a computer. To ensure that species identification is valid, at least 100 sporulated oocysts from each species were observed and measured according to Coudert et al. (1995) method.

### Statistical analysis

Prevalence of rabbit coccidiosis according to age, sex, chemoprevention, *Eimeria's* species and regions was calculated using SPSS (version 17 package) and analysed by Chi square test, and a value of  $p < 0.05$  was considered significant.

## RESULTS

### Prevalence of coccidial infection in rabbits of Medea province

A total of 414 samples were collected and analysed. Overall, coccidian oocysts of *Eimeria* were found in 197 of 414 faecal samples (46.7 %) obtained from six regions of Medea Province, Algeria. The prevalence of coccidian oocysts in these regions ranged from 34.4% to 59.5 % (Table 2). Benislimane region had the highest prevalence (59.5 %) and Ouzera region had the lowest prevalence (34.4 %). Weanling rabbits were the most infected with a prevalence of 77%, followed by growing and adult rabbits with prevalence of 46.8% and 36% respectively (differences were statistically significant,  $P < 0.0001$ ). Concerning breeding rabbits, females were more infected with a prevalence of 40% (Table 1).

### *Eimeria*'s species identification results

The morphological identification of *Eimeria* oocysts revealed the presence of the eleven known species of rabbits' *Eimeria*. *E. magna* and *E. media* were the most prevalent species (47.6 % and 47.3%,  $p < 0.0001$ ), followed in order by *E. stiedae*, *E. exigua*, *E. coecicola*, *E. flavescens*, *E. perforans*, *E. piriformis*, *E. vej dovskyi*, *E. irresidua* and *E. intestinalis* with prevalence of 43%, 36.2%, 21.7%, 20.8%, 20.5%, 17.9%, 12.8%, 11.1% and 8.7 %, respectively. (Table 3). *E. magna* and *E. media* were most prevalent in Bensilimane and Ouzera respectively (Table 4).

### Prevalence of coccidial infection in rabbits according to chemo-prevention

All of the 50 farms used anticoccidials to their rabbits for coccidiosis prevention, but 11 farms did not provide us the kinds of anticoccidials that they had used (Table 5). Colistine+Trimethoprim association (COLISULTRIX) and Sulfaquinoxaline sodium + Sulfadiazine sodium association (COCCIDIOPAN) are the most frequently used drugs in these farms. In farms using Colistine+Trimethoprim association, oocysts were found in 65.3% (98/150) of faecal samples compared to 23.3% (41/176) for those using Sulfaquinoxaline sodium + Sulfadiazine sodium association ( $p < 0.0001$ ).

**Table 1.** Prevalence and intensity of coccidial infection in local rabbits breed according to age and sex in Medea province, Algeria

Rabbit classes	Examined no	Positive no	Prevalence %	OPG	$\chi^2$	P value
Weanling	100	77	77.0	$[9 \times 10^2 - 1.5 \times 10^6]$	56.4	<0.0001
Growing	64	30	46.8	$[1.2 \times 10^2 - 9 \times 10^5]$		
Adults	50	18	36.0	$[7 \times 10^2 - 3 \times 10^5]$		
Breeding male	100	32	32.0	$[8 \times 10^2 - 9 \times 10^4]$		
Breeding female	100	40	40.0	$[1.3 \times 10^2 - 1.2 \times 10^5]$		

Examined no: number of fecal samples analyzed, OPG: Oocyst per gram counting

**Table 2.** Prevalence and intensity of coccidial infection in local rabbits breed in different regions of Medea province, Algeria

Examined regions	Examined no	Positive no	Prevalence %	OPG	$\chi^2$	P value
Benislimane	84	50	59.5	$[8 \times 10^2 - 4.5 \times 10^4]$	15.3	P=0.0089
Medea	78	37	47.4	$[9 \times 10^2 - 1.1 \times 10^6]$		
Berouaghia	62	36	58.1	$[1 \times 10^3 - 1.5 \times 10^6]$		
El Omaria	66	24	36.4	$[7 \times 10^2 - 2.6 \times 10^4]$		
Ouzera	64	22	34.4	$[9 \times 10^2 - 2.6 \times 10^4]$		
Ouamri	60	28	46.7	$[9 \times 10^2 - 5.9 \times 10^4]$		

Examined no: number of fecal samples analyzed, OPG: Oocyst per gram counting

**Table 3.** Prevalence of faecal samples infected with coccidia species in local rabbits breed in Medea province, Algeria

Species	Positive no	Prevalence %	OPG	$\chi^2$	P value
<i>E. exigua</i>	150	36.2	$[0 - 9.7 \times 10^4]$	650.7	<0.0001
<i>E. perforans</i>	85	20.5	$[0 - 4.6 \times 10^4]$		
<i>E. piriformis</i>	74	17.9	$[0 - 8.1 \times 10^3]$		
<i>E. flavescens</i>	86	20.8	$[0 - 1.4 \times 10^5]$		
<i>E. irresidua</i>	46	11.1	$[0 - 1.1 \times 10^4]$		
<i>E. stiedae</i>	178	43.0	$[0 - 4.2 \times 10^5]$		
<i>E. intestinalis</i>	36	8.7	$[0 - 5.2 \times 10^4]$		
<i>E. media</i>	196	47.3	$[0 - 4.3 \times 10^5]$		
<i>E. vej dovskyi</i>	53	12.8	$[0 - 1.5 \times 10^5]$		
<i>E. coecicola</i>	90	21.7	$[0 - 2.2 \times 10^4]$		
<i>E. magna</i>	197	47.6	$[2.5 \times 10^2 - 5.9 \times 10^5]$		

Examined no: number of fecal samples analyzed, OPG: Oocyst per gram counting

**Table 4.** Percentage of faecal samples infected with coccidia species in local rabbits breed in Medea province, Algeria

<i>Eimeria</i> species	Medea (n=37)	Benislimane (n=50)	Berouaghia (n=36)	El Omaria (n=24)	Ouzera (n=22)	Ouamri (n=28)
<i>E. exigua</i>	7.16%	8.74%	4.58%	4.13%	8.82%	8.21%
<i>E. perforans</i>	4.19%	0.98%	3.94%	5.17%	0.68%	2.64%
<i>E. piriformis</i>	3.11%	3.46%	2.56%	3.21%	2.32%	1.96%
<i>E. flavescens</i>	1.7%	3.58%	3.92%	3.21%	5.77%	4.11%
<i>E. irresidua</i>	1.03%	0.76%	0.67%	1.5%	2%	1.86%
<i>E. stiedae</i>	17.84%	14.04%	12.92%	7.29%	10.14%	18.82%
<i>E. intestinalis</i>	0.81%	2.46%	3.14%	0.75%	0.64%	0.79%
<i>E. media</i>	18.43%	18.44%	21.83%	24.21%	30.14%	18.32%
<i>E. vej dovskyi</i>	1.41%	0.76%	1.72%	1.63%	1.41%	1.04%
<i>E. coecicola</i>	2.59%	3.14%	3.72%	6.21%	2.95%	3.71%
<i>E. magna</i>	41.73%	43.64%	41%	42.71%	35.14%	38.54%

n: positive fecal samples

**Table 5.** Prevalence of local rabbits breed coccidial infection on farms according to the anticoccidial used in Medea province, Algeria

Anticoccidials	Examined no	Positive no	Prevalence %	OPG	$\chi^2$	P value
Colistin+ trimethoprim	150	98	65.3	$[8 \times 10^2 - 1.5 \times 10^6]$	72.4	<0.0001
Sulfonamides	176	41	23.3	$[9 \times 10^2 - 1.7 \times 10^5]$		
Unknown	88	58	65.9	$[9 \times 10^2 - 5 \times 10^5]$		

Examined no: number of fecal samples analyzed, OPG: Oocyst per gram counting

## DISCUSSION

Coccidiosis constitutes a major health problem in rabbit breeding affecting mainly young rabbits after weaning (Drouet-Viard et al., 1997b, Pakandl and Hlálková, 2007). In the present study, the prevalence of coccidia infection in six regions of Medea Province was surveyed. Based on the analysis of 414 faecal samples collected from 50 rabbit farms, the overall infection rate was 47.6 %. Due to the importance of the disease there is a continuous use of coccidiostat sat farm level but in spite of this the prevalence of coccidiosis is still high. This may be explained by maternal transmission of coccidiosis to young rabbits (Henneb and Aissi, 2013; Papeschi et al., 2013). Furthermore, in rabbit breeding, therapy should concern not only the young rabbits but also the nursing females mainly during the week preceding weaning where the contamination from mother to young rabbits takes place (Pakandl and Hlálková, 2007). The existence of all rabbits' *Eimeria* species was confirmed in these faecal samples. As reported previously, the natural infections with a single *Eimeria* species are rare (Abdel-Baki and Al-Quraishy, 2013; Jing et al., 2012). The prevalence of *E. magna* in Medea province was convergent to the reported by Henneb and Aissi (2013) in Eastern Algeria and Maziz-Bettahar et al. (2018) in Northern Algeria (47.6% versus 43% and 42.5% respectively) which could be due to poor hygiene noticed in Algeria's farms (Henneb and Aissi, 2013). Gonzalez-Redondo et al. (2008) confirmed that a fair control of hygienic conditions is sufficient to maintain a low level of coccidia and also Schlotaut et al. (2013) indicated that housing conditions could have an impact on health of rabbits. *E. magna* and *E. media* which are recognized as mildly pathogenic (Licois et al., 1995; Drouet-Viard et al., 1997a, Drouet-Viard et al., 1997b) were the most predominant in Medea followed by *E. stiedae* but OPG values for these samples were less than concerning clinical coccidiosis. This result indicated that sub-clinical coccidiosis is common in Medea province. In fact sub-clinically infected rabbits looked to be healthy in general, but have reduced feed conversion and growth performance, resulting in huge economic losses as reported by Jing et al. (2012), Okumu et al. (2014) and Yin et al. (2016). The prevalence of coccidian oocysts in weaner rabbits was higher than growing rabbits and adult rabbits, this could be due to lower resistance or incomplete immunity against coccidiosis in young rabbits compared to elder animals as described previously by Licois et al. (1995); Drouet-Viard et al. (1997a,b); Pakandl et al. (2008); Pakandl (2009); El-Ghoneimy and El-Shahawy (2017) and Geru et al. (2017).

## CONCLUSION

The present survey revealed that rabbit coccidiosis prevalence in Medea Province, Algeria, is not negligible. In fact, an overall infection rate of 47.6% has been registered. The study revealed that *E. magna* and *E. media* were the most predominant species and weanling rabbits were the most infected followed by growing and adult rabbits. Females were more infected than males and coccidiopan seems to be more effective than colisultrix. Knowledge about the prevalence of coccidiosis and current *Eimeria* species will help to evaluate the infection potential and control programs, and therefore minimizing the economic losses caused by this disease.

## DECLARATIONS

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### Competing interests

The authors declare that they have no conflict of interests.

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### Author's contributions

MSB proposed and conducted the study. MSB and AB drafted and revised the manuscript. ST, HA supervised the work. MSB and AB analyzed the data. All authors read and approved the final manuscript.

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