Veterinaria, Vol. 69, No.1, 2020
Stručni članak (*non peer review*)

Contribution to studying ecto and mesoparasites in goats in Southern Algeria

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Abstract

The present work is aimed at conducting a screening survey to determine the parasites infesting goats in Algeria evaluation of their prevalence, and studying the influence of some risk factors on the incidence of these parasites. For this reason, the fact sheets on 100 animals belonging to 10 visited farmers were filled, macroscopic research of ectoparasites was completed and the faecal samples were taken. Different methods such as direct examination, flotation method, the method of Ritchie, Lugol staining technique and modified Ziehl - Neelsen staining were used to identify the parasite eggs. The results showed a total prevalence of vermin infestation of 97%. The observed mesoparasites were: *Eimeria spp.* (89%), *Cryptosporidium spp*. (70%), *Ostertagia spp*. (19%), *Nematodirus spp*. (14%), *Skrjabinema spp*. (10%) and *Strongyloides spp*. (8%). Ectoparasites were detected in 3% of examined goats and they were represented by two species of lice: *Linognathus africanus* (3%) and *Damalinia caprae* (3%). Following the statistical analysis of the influence of some risk factors, we obtained a significant influence of age (p= 0,004) on the parasitic infestation rate of the examined goats.

Key words: survey, mesoparasites, ectoparasites, goats, Laghouat

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Introduction

Small ruminant farming is one of the most important agricultural activities in the world. It plays a fundamental role at the economic, ecological, environmental and cultural levels (Zervas et al., 1996). As in all Maghreb countries, goat farming is one of the most traditional strategic activities in Algeria. It plays an important role in the national agricultural economy as well as for livestock farmers, thus presenting a considerable financial reserve (El Bouyahiaoui, 2014). Goats are among the most widespread livestock on the globe (FAO, 2007), spreading from the equator to the coldest climatic zones (Maudet, 2001). In Algeria, goat herds remain a marginal population representing only 13% of the national herd, and are often associated with sheep farming (Fantazi, 2004).

In general, goats are very resistant, but still remain prone to certain diseases against which they have a few defences, causing a very high mortality : The case of "Peste des petits ruminants" (Grech, 2012). Other common diseases that can affect goats include intestinal parasites, ticks, and scabies (Salifou et al., 2004).

Parasitism is a phenomenon that affects all life, and is widespread throughout the world. It is a biological relationship in which one of the protagonists (the parasite) benefits (by feeding, sheltering, or reproducing) from one or several other organisms (hosts), and the relationships between hosts and parasites are incredibly diverse (Hallé, 2010). In Algeria, the identified internal parasites of domestic ruminants are essentially nematodes (22 genera), cestodes (9 genera) and trematodes (3 genera) (Mekhancha, 1988).

This study is aimed at searching for the ecto and mesoparasites in goats in the region of Laghouat in Algeria, evaluating their prevalence, and establishing the relation between infestation and some physiological parameters.

Material and methods

Our study was carried out from February- April, 2017, and took place at different sites of the Laghouat region in Southern Algeria.

Farms

To carry out our investigation, we chose 10 farms located in six different towns of Laghouat region. All investigated breeders stated they were goat farming for the purpose of livestock fattening, or the production and self-consumption of milk.

Animals included in the study

In order to search for ectoparasites and endoparasites, 100 goats were included in the study, 94 females and 6 males. 15 goats were classified as young (≤ one year) and 85 as adults (> one year). The characteristics of these animals are presented in Table 1.

Table 1. Description of the examined goats

Criteria	Variables	Number per site						Total number	%
		S1	S2	S3	S4	S5	S6	06	
Race	Local	02	21	12	33	12	02	49	49%
	Hybrid	01	00	00	00	00	15	16	16%
	Imported	02	00	00	00	00	00	02	02%
Age	Young	00	07	02	04	01	01	15	15%
	Adult	05	14	10	29	11	16	85	85%
Hygiene	Dirty	00	00	00	00	00	00	00	00%
	Clean	100	100	100	100	100	100	100	100%
BCS	Big	00	01	00	03	02	00	06	06%
	Skinny	00	01	00	07	00	00	08	08%
	Normal	05	19	12	23	10	17	86	86%

S: site.

All of the examined animals appeared to be healthy without clinical signs of disease. They were local (Arbia), crossed (Makatia) and imported (Saanen) breeds. The age of the studied animals was obtained from the breeders. The BCS (body condition score) was assessed by examination of certain regions of the animal body (fat covering the hips, the ribs and the loins). The animals hygiene was estimated by observing dirtiness or cleanliness, especially of the thighs and limbs.

Survey methods

A survey was conducted with the Directorate of Agricultural Services to collect data on the number and distribution of goat herds in Laghouat region. To proceed with our sampling, we randomly selected some goat farms from the presented sites. A field survey was carried out with the breeders to obtain a clear picture of the visited farms' characteristics. For this, we filled out a technical sheet for each breeder. At the same time, we carried out a clinical examination of each sampled animal by recording all relevant information.

Examination methods

Samples collection and conservation technique

Faeces

The faeces were taken directly from the rectum by stimulating the goat's anus with the gloves or immediately after defecation in order to avoid contamination by the loose nematodes from the external environment. Faecal samples were collected in the sterile, sealed and labelled jars. The samples were then stored in the refrigerator at + 4° C, or sent directly to the parasitology laboratory at the Department of Biology at Amar Thelidji University in Laghouat (Algeria).

Dang and Beugnet (2000), William (2001) and Guillaume (2007) identification methods were used for the mesoparasites identification.

The ectoparasites

We collected the ectoparasites manually by the careful search through the animal's fur, ears and belly. The pests were then stored in a tube containing 70% ethanol. Identification of the ectoparasites was performed using a binocular magnifier as previously described (William, 2001; Baker, 2007).

Macroscopic examination of the stools

Macroscopic examination performed evaluating the faeces with the naked eye was the first step, and included noting down the color, appearance of the faeces and presence of blood, pus or mucus, and presence of the adult forms of certain parasites (roundworms, pinworms, taenia rings).

Microscopic study of the samples

Microscopic analysis represented the second step which consisted of:

Direct examination

This is a simple method as it does not require many manipulations. It allowed us to study the vegetative forms of the protozoa as well as the larvae of anguillules and ankylostomes. It consists of mixing a small amount of recently collected faeces with a drop of saline, followed by a drop of the mixture between the glass lamina and the lamella. Microscopic examination is performed at 40x magnification (Guillaume, 2007). For this examination, and in order to facilitate the morphological study, a drop of saline or a drop of 1% Lugol was used.

Ritchie technique (simplified by Allen and Ridley, 1981)

It is a two-phase method (physico-chemical), which involves the hydrophilic-lipophilic balance of the parasite. It stems from the method of Telemann (1908) who diluted the stools in an equal mixture of ether and hydrochloric acid. It is known for its specificity and sensitivity to

Giardia, especially after staining with Lugol's solution, which colours the Giardia cysts in orange enabling their visualization. Microscopic observation is performed at 40x magnification.

Willis technique (Floatation)

It is a flotation method used for detection, of the helminthic eggs which are less dense than the saturated salt solution (Nacl 25%), so they float (Chouidda, 2001).

Ziehl-Neelsen technique

This method is essential for detection of Cryptosporidium oocysts. The staining enables visualization of the *Cryptosporidium oocysts*, which contain four sporozoites arranged around a rounded residual body, in bright red colour (Henriksen et Pohlenz, 1981).

Analysis indices

Prevalence

It is the ratio in percentage **P** (%) of the number of hosts infested by a given species of pests **HP** on the total number of hosts examined **HE** (Margolis et al., 1982).

P (%) = HP/ HE × 100

In this study, we calculated the prevalence for each type of parasite.

Statistical study

Version 20 of the SPSS software was used in the statistical analysis. Khi-deux test was used, and the difference is considered significant when the error risk is less than 5%.

Results

Mesoparasites

Microscopic examination

Parasitological examination of the stools revealed six species of parasites. Two intestinal coccidias, *Eimeria spp.* and *Cryptosporidium spp*., and four types of the nematodes: *Strongyloides spp*., *Nematodirus spp*., *Ostertagia spp.* and *Skrjabinema spp.*

Ectoparasites

Visualization through the binocular loupe

Morphological identification of the specimens enabled detection of two species of the lice: *Linognathus africanus* and *Damalinia caprae.*

Parasitic index

Total prevalence of parasitism

Out of 100 examined subjects, 97 goats had either the mesoparasites or the ectoparasites (a total prevalence of 97%).

Mesoparasites prevalence

Out of 100 examined faecal samples, 97 tested positive (a prevalence of 97%). In the highest prevalence was Eimeria spp. (89%), followed by *Cryptosporidium spp*. (70%), *Ostertagia spp*. (19%), *Nematodirus spp*. (14%), *Skrjabinema spp*. (10%), and finally, *Strongyloides spp*. (8%).

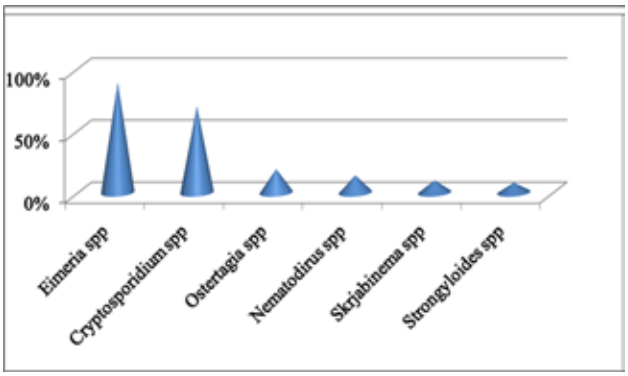

Figure: The prevalence of each kind of mesoparasites in goats.

Ectoparasites prevalence

Out of 100 examined animals, 3 goats were infested by the ectoparasites. The prevalence of *Linognathus africanus* was similar to that of *Damalinia caprae*, with a rate of 3%.

Pest association percentage

Table 2 shows that most often a single animal was infested by 2 parasites (*Eimeria and Cryptosporidium*), with a 57 % rate. The association of 3 parasitic genera (*Eimeria, Cryptosporidium* and *Ostertagia/Nematodirus*) was observed in 12 goats, with a 12% rate. Finally, the association of 4 parasitic species is less frequent, with a 10% rate.

Table 2 Explains polyparasitism and monoparasitism

Number of parasites encountered in the same individual	Infested goats	Percentage
1	18	18%
2	57	57%
3	12	12%
4	10	10%

Risk factors for parasitism in goats

Some parameters such as age, race, and BCS t were analysed to evaluate their potential influence on the prevalence of the encountered ecto and mesoparasites (Table 3).

Parasitic infestation in the "Arbia" breed (98.68%) appeared to be higher than that in the "Makatia" (94.11%) and "Saanen" breed (85.71%). However, the statistical

Table 3. Parameters influencing goat parasitism

Criteria	Variables	% parasitism	P value
Race	Local	98.68	0.11
	Hybrid	94.11	
	Imported	85.71	
Age	Young	88.88	0.004
	Adult	100	
BCS	Big	100	0.77
	Skinny	100	
	Normal	96.51	

analysis revealed no significant difference (p = 0.117). The parasitism rate in adults (100%) was higher than in the young animals (88.88%). Statistical analysis revealed signicicant difference (p = 0.004).

Data showed that medium-sized subjects were infested with a 96.51% rate, andlarge and skinny goats with a 100%. However, the statistical analysis revealed that the difference was not significant between these categories (p = 0.77).

Our aim is to study the most common parasites in goats raised in Laghouat region. The reason for studying goats is the scarcity of studies on them in Laghouat so far. We used different methods to search for the mesoparasites. These methods are standard and known as: (Guillaume, 2007) direct examination for the protozoa, (Urquhart et al., 1996) and Ritchie (Barr et Bowman, 1992) flotation method for the nematodes, cestodes and trematodes mesoparasites. We used Ziehl-Neelsen coloration method to search for Cryptosporidium (Henriksen et Pohlenz, 1981).

After analysing the samples, we found out that they were infested with at least one type of parasite with the highest prevalence of the mesoparasites (97%) represented by six types of parasites. Ectoparasites were represented by two species of lice and had a prevalence rate of (3%).

As for the mesoparasites, in 100 goat samples we found: Eimeria spp with an 89% prevalence rate, *Cryptosporidium spp*. (70%), *Ostertagia spp*. (19%), *Nematodirus spp.* (14%), *Skrjabinema spp*. (10%) and finally, *Strongyloides spp*. (8%).

Ectoparasites had a 3% prevalence rate, and were represented by two species of lice: *Linognathus africanus* and *Damalinia caprae*.

Our results for Eimeria spp. (89%) are significantly higher than those found in Togo with only 31% (Bastiaensen and al., 2003). On the other hand, the prevalence rate recorded by Cavalcante and al. (2012) in Brazil and Ramisz and al. (2012) in Ukraine and Poland were closer to our value at 91.2% and 74%, respectively.

We could attribute the high prevalence rate of this parasite species to the lack of hygiene on the farms, on one hand and the mixture of ages and animal species (sheep, calves), on the other hand. Such situation favours persisting infestation, and increases the chance of animal contamination In addition, contamination is also supported by resistance that Coccidia shows in the external environment (several months and even years) (Chartier, 1999, Delafosse et al., 2003). It explains the presence of this parasite despite the rough environmental conditions.

Cryptosporidia had a prevalence rate of 70%, and it is significantly higher than the 46,44% rate found by Baroudi and al. (2011) in Algiers. Often, infection is the result of a colibacillary infection in the first week, which gets complicated in the 2nd week into cryptosporidiosis. Once present in some animals, infestation spreads rapidly to the other animals. (Chartier, 1999).

We can attribute the high incidence of the parasite to susceptibility of the studied animal species. Indeed, the disease is mainly manifested by digestive symptoms. Goats, especially the young ones are known for being a very sensitive species, with high morbidity, and a mortality rate that reaches 80% (Chartier, 1999).

From another end, the coexistence of other animal species (poultry, equines, sheep, canidae) in the surveyed farms adds up to explain in part the high percentage of this parasite.

For Ostertagia spp, the prevalence rate recorded in our study was 19%. Such result is similar to that reported in Rwanda by Nshimiyimana and al. (2011) (20%). However, it was less than what was reported in China by Ma and al. (2014) (32,6%). The difference in the prevalence rate could be attributed to the variation of different factors from one study to another. Indeed, the results may vary according to climatic variations and the number of samples taken (Ma and al., 2014). Triki-Yamani (2009) also showed that the prevalence of Ostertagia spp depended on temperature and humidity.

For Nematodirus spp., the prevalence rate recorded in our study was 14%, which is similar to what was reported in France by Hoste and al. (1999) (10%). However, a high prevalence rate was recorded by Nshimiyimana and al. (2011) in Rwanda (20%). Detected and bibliographically confirmed were the eggs of the parasite . The eggs can be found in the animal faeces however, the adults only lay eggs two to four weeks after the infestation. (Charles and Robinson, 2006).

For Skrjabinema spp., the prevalence rate recorded in our study was 10%, which is comparable with that found in Ethiopia of 11,5% (Terefe and al, 2012), but lower than that by Nwosu and al., 1996) in Niger (31%). However, it was a way higher than what was recorded by Juan (2014) in California (2,6%). We could attribute this difference to the geographical distribution and climatic conditions such as temperature, humidity and rainfall.

For Strongyloides spp, the prevalence rate recorded in our study was 8%, which is higher than that recorded in Ethiopia (Terefe and al, 2012) (4,7%), but still lower than that of Hassan and Ciroma, 1991 in Bangladesh, and Salifou and al, 2004 in South Benin (51,74% and 30,47, respectively).

As for the ectoparasites, we found two lice species that affect goats: Linognathus africanus (3%) and Damalinia caprae (3%). These two lice species can cause anaemia in young goats, and hair loss due to scraping to relieve the itch (Kettle, 1995). The prevalence rate of these two species of the ectoparasites is very low compared to that found in Ethiopia with (27,9%) (Mulugeta et al., 2010).

During our study, which spanned a time period from February- May, we did not find any tick species. Such absence is explained by non-coincidence of our sampling with the period of activity of the ticks, which has minimized the chance of finding this parasite type in the surveyed goats.

There were cases of polyparasitism (more than one parasitic species in the same individual), and it was dominated by the case of two parasites. This is not in concordance with Cuervo and al. (2013) results, when more animals were detected infested by a single parasite than with more parasitic species. In this study, the authors also found the following parasitic associations: *Eimeria* + *Nematodirus* (15.38%) and *Fasciola hepatica* + *Eimeria* (11.01%).

The associations found in our study were: Eimeria + *Cryptosporidium* (57 %) and *Eimeria* + *Cryptosporidium* + *Ostertagia* / *Nematodirus* (12%).

Such difference could be explained by the variation of several environmental factors that can positively or negatively affect the spatial distribution of parasites.

For the impact of some parameters such as age, animal BCS, the breed and the study site to infestation with different parasites found in the studied goats, the statistical analysis revealed no significant difference except for age.

Conclusion and perspectives

Our study, which is the first of its kind in the Laghouat region, is aimed at assessing the prevalence of the mesoparasites and ectoparasites in goats in the region, while addressing the relationship between their infestation and some physiological parameters. For this reason, we examined one hundred (100) subjects. The obtained results showed that all of our samples presented with parasitism with at least one type of parasite.

We recorded a total prevalence rate of 97% for six mesoparasites species that were observed, with variable prevalence from one species to another. The highest prevalence was of *Eimeria spp*. (89%) followed by *Cryptosporidium spp*. (70%), *Ostertagia spp*. (19%), *Nematodirus spp*. (14%), *Skrjabinema spp*. (10%) and finally, *Strongyloides spp.* (8%).

Ectoparasites were represented by 2 lice species: Linognathus africanus (3%) and Damalinia caprae (3%).

Following our investigation, we conclude that goats present an important reservoir for different parasites, which are responsible for various diseases of great affluence and severity. From our study, we present several perspectives that can be envisaged:

- Expansion of the research period and enlargement of the investigation field to include other areas that differ in their ecological and climatic characteristics from ours, while increasing the number of samples.
- For better confirmation and identification of the parasite species, further studies such as genetics are required.
- Finally, and for the future studies, it is proposed to deepen our knowledge on the host-parasite relation and interactions, follow their evolution over time, and include other parameters in the studies, particularly the impact of the ecological factors.

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Doprinos proučavanju ektoparazita i endoparazita kod koza u južnom Alžiru

Sažetak

Uvod

Uzgoj koza predstavlja jednu od najvažnijih poljoprivrednih djelatnosti u svijetu igrajući ključnu ulogu sa ekonomskog, ekološkog, okolišnog i kulturalnog aspekta. Uzgoj malih preživača je jedna od najtradicionalnijih strateških aktivnosti u Alžiru, kao i u ostalim zemljama Magreba. Ovaj uzgoj igra relativno značajnu ulogu kako u nacionalnoj poljoprivrednoj ekonomiji tako i za male stočare, pružajući značajan izvor prihoda. Država je poduzela opsežne aktivnosti kako bi unaprijedila stočarstvo u cjelini. Međutim, uzgoj stoke, posebno koza, je i dalje izložen opasnostima. Uzgoj stoke ovisi o mnogobrojnim klimatskim, zdravstvenim i ekonomskim problemima koji utječu na proizvodnju i reprodukciju. Od zdravstvenih problema možemo izdvojiti bakterijske, virusne i parazitarne bolesti, pri čemu ove posljednje imaju najveći značaj zahvaljujući korištenju pašnjaka koji su infestirani slobodnim formama parazita koje se razvijaju u povoljnim klimatskim periodima. Paraziti su odgovorni za značajno smanjenje proizvodnje mlijeka i mesa, a mogu biti i uzročnici mortaliteta na farmama koza. S obzirom da imaju i značajan učinak na javno zdravlje, kontrola parazitoza se trenutno smatra osnovnim elementom upravljanja zdravstvenim stanjem stada. U Alžiru nije provedeno dovoljno detaljnih istraživanja o infestacijama parazitima malih preživača koje mogu imati značajne ekonomske posljedice.

Cilj našeg istraživanja je skrining u svrhu identifikacije parazita koji infestiraju koze u Alžiru sa procjenom njihove prevalence, kao i procjena utjecaja pojedinih riziko-faktora na incidencu ovih parazitoza.

Materijali i metode

Prikupljeni su upitnici za 100 životinja sa 10 farmi. Ove farme se nalaze u šest različitih gradova u regiji Laghouat (jug Alžira). Svi ispitivani uzgajivači su izjavili da se bave uzgojem koza radi

tovljenja ili proizvodnje i potrošnje mlijeka. Ispitane životinje su se doimale zdravim, bez kliničkih znakova bolesti, a pripadale su domaćim (Arbia), križanim (Makatia) i uvezenim (Saanen) pasminama. Podatke o starosti životinja smo pribavili od uzgajivača. Ocjena stanja tijela (BCS-*body condition score*) je procijenjena pregledom određenih regija tijela životinja (mast koja prekriva kukove, rebra i slabine). Higijena životinja je procijenjena vizualnim pregledom prljavosti ili čistoće, posebno u području bedara i ekstremiteta. Istraživanje je provedeno u suradnji sa Direktoratom za poljoprivredne djelatnosti kako bi se prikupili podaci o broju i distribuciji kozjih stada u regiji Laghouat. Da bismo uzeli uzorke za ispitivanje, randomizirali smo određene farme koza sa prethodno predstavljenih lokacija. Terensko istraživanje je provedeno zajedno sa uzgajivačima kako bismo stekli jasnu sliku o karakteristikama posjećenih farmi. Iz ovog razloga smo za svakog uzgajivača kreirali upitnik sa tehničkim podacima. U isto vrijeme smo obavili klinički pregled svake pojedinačne životinje uz bilježenje svih relevantnih informacija.

Feces je uzorkovan direktno iz rektuma ili neposredno nakon defekacije kako bi se izbjegla kontaminacija slobodnim nematodoma iz vanjske sredine. Fekalni uzorci su prikupljeni u sterilne, zapečaćene i označene posude. Potom su uzorci uskladišteni u frižider na +4° C ili su poslani direktno u parazitološki laboratorij Katedre za biologiju na Univerzitetu Amar Thelidji u Laghouatu (Alžir). Ektoparazite smo prikupljali manualno pažljivim pretraživanjem životinjskog krzna, ušiju i stomaka, a potom ih skladištili u epruvete sa 70%-im etanolom. Ektoparazite smo identificirali korištenjem binokularnog povećala. Obavljen je makroskopski pregled ektoparazita i uzeti su uzorci fecesa. Za identifikaciju jaja parazita su korištene različite metode: direktni pregled, flotacija, Ritchie metod, bojenje Lugolovom otopinom i modificirano bojenje po Ziehl-Neelsenu.

Statistička analiza

U statističkoj obradi je korišten SPSS, verzija 20. Korišten je Khi-deux test, a razlika se smatra statistički signifikantnom ako je rizik od pogreške manji od 5%.

Rezultati

Rezultati su pokazali da je ukupna prevalenca infestacije parazitima 97%, a za ispitivane mezoparazite: Eimeria spp. (89%), Cryptosporidium spp. (70%), Ostertagia spp. (19%), Nematodirus spp. (14%), Skrjabinema spp. (10%) i Strongyloides spp. (8%). Ektoparaziti su otkriveni kod 3% pregledanih koza, a predstavljeni su sa dva tipa ušiju: Linognathus africanus (3%) i Damalinia caprae (3%). Nakon statističke analize utjecaja pojedinih riziko-faktora, ustanovili smo da starost ima statističku signifikantnost za parazitarne infestacije kod pregledanih koza (p=0,004).

Zaključak

Naše istraživanje je proširilo znanje o infestaciji parazitima kozje populacije u regiji Laghouat. U budućnosti bi bilo zanimljivo provesti daljnja istraživanja parazitizma kod stoke u određenom vremenu i na određenom prostoru kako bismo stekli jasniju sliku o epidemiologiji parazitarnih oboljenja.

Ključne riječi: istraživanje, mezoparaziti, ektoparaziti, koze, Laghouat