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Cysticercus tenuicollis in small ruminants of Algeria: abattoir survey, biochemical and morphological characterizations

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Abstract

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The present study was designed to determine the prevalence of *Cysticercus tenuicollis* in Tiaret Abattoir (Algeria) and compare biochemical profiles of some metacestodes collected from sheep and goats. 1973 sheep and 1175 goats examined, 155 carcasses of sheep and 263 of goats harbored the cysts, representing infection rates of 7.8 and 22.3%, respectively ($p < 0.05$). In both sheep and goats, the rate infection of *C. tenuicollis* was significantly higher in male than female. In sheep, liver was the most infected organ. In goats, omentum and liver were the most infected. Various biochemical parameters (glucose, cholesterol, triglycerides, urea, sodium, potassium and chlorine) were measured using conventional laboratory methods for a total of 24 cysts (13 cysts from goats and 11 from sheep). Cholesterol and triglycerides have higher mean in parasite bladders of sheep but glucose had higher mean in goats. Urea showed equal mean and range both in parasite bladders of sheep and goats. For the minerals, sodium and chlorine showed higher mean in goats and only potassium had higher mean in sheep. Morphological criteria showed significant differences ($p < 0.05$) between those of sheep and goats, namely: the length of the small hook blade, the length of the large hook blade, the length of the handle of the small hook and the length of the handle of the large hook. Numerous biochemical and morphological parameters studied showed significant differences. These suggest the existence of different sub-species of *T. hydatigena* in the study area.

Keywords: Cysticercus tenuicollis; small ruminants; biochemical profiles; Rostellar hooks; Algeria

Introduction

Cestodes of the family Taeniidae infect dogs as the definitive host and are transmitted to a wide range of intermediate host species where they cause coenurosis, hydatidosis, and cysticercosis. Infestations with the larval stage of some species of Taenia are not only of public health importance, but also of veterinary significance because they cause economic losses due to condemnation of infected offal or meat (Oryan et al., 2012). Cysticercus tenuicollis is the larval stage of the taeniid cestodes *T. hydatigena.* The adult worms are found in the small intestine of canines such as dogs and foxes, while the metacestodes are found in large number of domestic and wild intermediate ruminant hosts (Omar et al., 2016). These metacestodes are found on the different visceral organs such as liver, spleen, omentum, kidney, heart etc. of sheep, goat and pig (Nath et al., 2010). Size of the cysts varies from one cm up to 6-7 cm, and the scolex has a long neck (Singh et al., 2015).

C. tenuicollis infection in liver causes hepatitis, burrowing canal, granular degeneration, deposition of serofibrinous exudates and in lungs it causes pneumonia (Nath et al., 2011; Shivasharanappa et al., 2011) and in very heavy infections, the migrating larvae destroy the hepatic cells with eosinophilic infiltration and severe inflammation that may prove to be fatal (Saulawa et al., 2011). Biochemical substance within *C. tenuicollis* could be important for metabolism, physiology, and immunology and genetically with various isolates through all over the world as individual variation. This phenomenon observed in hydatid cyst of echinococcosis in human or animals (Radfar et al., 2005).

Previous studies suggest that inspection of sheep at abattoirs represents one of the perfect and accurate methods of diagnosis of metacestodes infection (Saulawa et al., 2011). Furthemore, no study has yet been carried out in Algeria on *C. tenuicollis* or comparative biochemical analysis to assess the similarity and/or differences between the cystic fluids of sheep and goats which could be useful to determine subspecies of *T. hydatigena*. Therefore, the present work was conducted to determine the prevalence of *C. tenuicollis*, indicate the sex and organs infected in sheep and goats in Tiaret Abattoir and compare some biochemical profiles of cyst fluids and some morphological parameters of protoscoleces in sheep and goats.

Materials and Methods

Study area

The present study was conducted in the Abattoir of Tiaret. The region is situated in the high plateau of Algeria, a semi-arid area characterized by cold and humid winter and hot and dry summer. The laboratory work was done at the Veterinary Sciences Institute of Ibn Khaldoun University of Tiaret.

Examination of slaughtered animals

From April to December 2010, the Tiaret Abattoir was visited periodically to examine slaughtered sheep and goats for *C. tenuicollis*. Body cavities including the thorax, abdomen and pelvis of 1973 sheep and 1175 goats were carefully inspected for the possible detection of the cyst which could be found in the pleura, visceral and peritoneum either within these organs or suspended cysts. Transparent cysts with clear fluid and with a long neck with white corn sized spots in the fluid were considered to be *C. tenuicollis* (Soulsby, 1982; Kaufmann, 1996).

The cysts were conducted to the laboratory of parasitology of the Veterinary Sciences Institute of Ibn Khaldoun University of Tiaret for more investigations.

Biochemical analysis

From a total of 24 cysts obtained essentially from omentum of small ruminants (13 cysts from goats and 11 from sheep), the cyst fluid was aspirated by using sterile disposal syringes and was centrifuged at 3000 rpm for five minutes then supernatant fluid was stored in -20°C until use. Levels of total proteins, glucose, triglycerides, cholesterol and calcium were determined using a SECOMAM Basic analyzer (France). Sodium, chlorine and potassium levels were determined by plasmatic selective electrodes "Medica Easylyte ILyte Electrolyte Analyzer (UK)".

The variation between infection rates of species, age, sex, specific organs and biochemical parameters were evaluated by statistical tests using Student test (STATISTICA, SOFTWARE). P values of less than 0.05 were regarded as significant.

Morphological study of hooks of *C. tenuicollis* of ovine and caprine animals

Forty *C. tenuicollis*, mostly attached to omentums and livers of small ruminants (20 sheep and 20 goats), were used for the morphological study of the large and small hooks of protoscolex. After incision of *C. tenuicollis*, the protoscolex was recovered and placed between two microscopic slides and sufficient digital pressure was used to flatten the hooks. All measurements were made by the same person using Optika Micro Image Analysis Software (At the level of the laboratory of agro-biotechnology and nutrition in semi-arid zone of the Faculty of life sciences of Tiaret). The total number of large and small hooks (made on 20 protoscolex from sheep and 20 protoscolex from goat) and other parts of the hooks were measured:

- The length of the blade of the large hook (made on 50 hooks),
- The length of the blade of the small hook (made on 50 hooks),
- The length of the handle of the large hook (made on 50 hooks),
- The length of the handle of the small hook (made on 50 hooks),
- The total length of the large hook (made on 60 hooks),
- The total length of the small hook (made on 60 hooks).

Results

Out of total 1973 sheep and 1175 goats were investigated for infection with *C. tenuicollis* cyst. 155 sheep (7.8%) and 263 goats (22.3%) were infected (Table 1, 2). The *C. tenuicollis* cyst frequency in goats was greater, and statistically significant ($p < 0.05$) then the sheep.

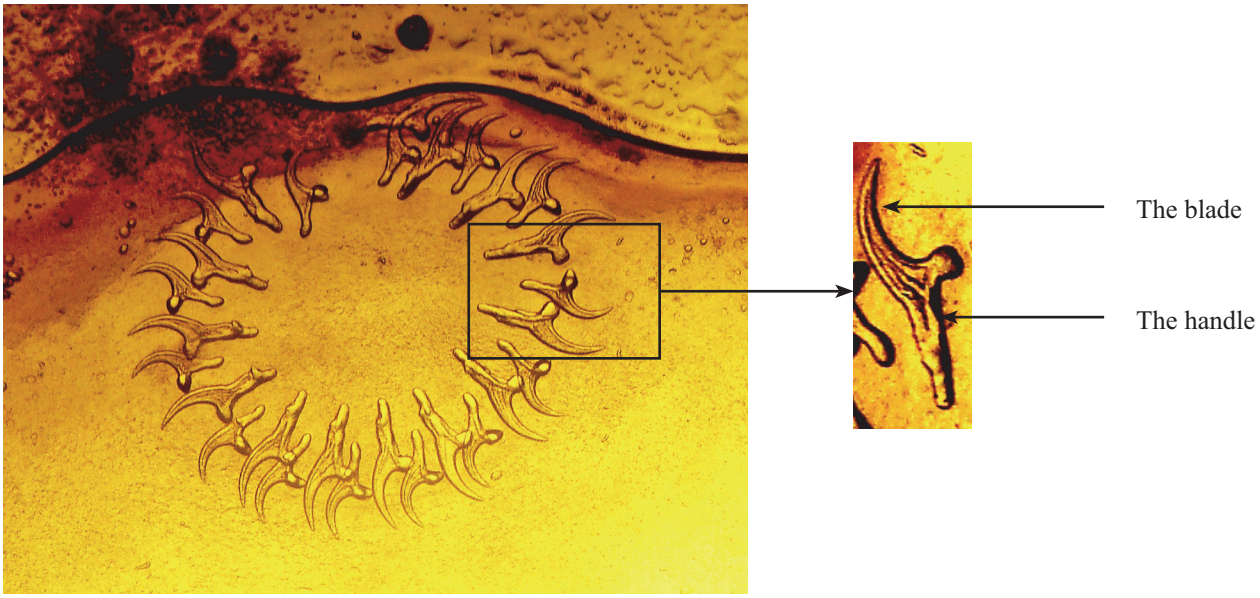

Fig. 1. Hooks of a protoscolex of *C. tenuicolis* seen under the optical microscope

Table 1
Infection rates of *C. tenuicollis* in sheep and goats slaughtered in Tiaret Abattoir

Animals	Number of examined animals	Infected animals	
		No	%
Sheep	1973	155	7.8
Goats	1175	263	22.8*

*p < 0.05

Table 2
The prevalence of *C. tenuicollis* in male and female

Species	Number of examined animals	Sex	Infected animals	
			Number	%
Sheep	1973	Male	136	6.8
		Female	19	0.96
Goats	1175	Male	155	13.1
		Female	108	9.19

Table 3
Distribution of *C. tenuicollis* in visceral organs of sheep and goats

Species	Visceral organ	Number	%
Sheep	Liver only	131	84.5
	Omentum only	9	5.8
	Liver and omentum	15	9.6
Goats	Liver only	108	41
	Omentum only	109	41.4
	Liver and omentum	46	17.4

Our research showed that in sheep, liver (84.5%) was the most infected organ ($p < 0.05$). In goats, omentum and liver were the most infected with 41.4% and 41% respectively (Table 3).

Biochemical results revealed that cholesterol and triglycerides have higher mean in parasite bladders of sheep but glucose had higher mean in goats. Urea showed equal mean and range both in parasite bladders of sheep and goats. For the minerals, sodium and chlorine showed higher mean in goats and only potassium had higher mean in sheep, in spite the absence of significant difference between the various biochemical parameters (Table 4).

Morphological characteristics of the hooks of *C. tenuicollis* are seen in Table 5. In the light of this table, it can be seen that the *C. tenuicollis* of sheep and goats have a similar appearance with two rows of hooks (the large and the small

Table 4
Biochemical and chemical values of cystic fluids from sheep and goats (mean ± S.E)

Biochemical profiles	Sheep	Goats
Glucose (g/l)	1.37±0.62	1.42±0.81
Cholesterol (g/l)	2.42±1.18	2.21±1.14
Triglycerides (g/l)	0.92±1.31	0.45±0.34
Urea (g/l)	0.58±0.03	0.58±0.03
Sodium (mmol/l)	126.79±18.07	133.71±5.99
Potassium (mmol/l)	9.38±2.49	8.51±0.63
Chlorine (mmol/l)	116.40±20.03	120.39±5.60

Table 5
Rostellar hook characteristics of *C. tenuicollis* from sheep and goats: (mean ± S.E)

Rostellar characteristics		*C. tenuicollis* from sheep	*C. tenuicollis* from goats
Arrangement of hooks		Large and small hooks alternating in 2 rows	Large and small hooks alternating in 2 rows
Large hooks	No. of hooks	15±1.12	14.9±0.85
	Blade length (µm)	85.05±4.34*	77.85±3.51*
	Handle length (µm)	95.97±7.18*	101.71±6.63*
	Total length (µm)	201.56±7.22	199.49±7.04
Small hooks	No. of hooks	15.1±0.72	15.1±0.79
	Blade length (µm)	62.52±4.65*	57.27±4.59*
	Handle length (µm)	50.88±6.42*	56.82±6.25*
	Total length (µm)	131.01±6.50	132.06±7.31

Fig. 2. *C. tenuicollis* in lever of sheep

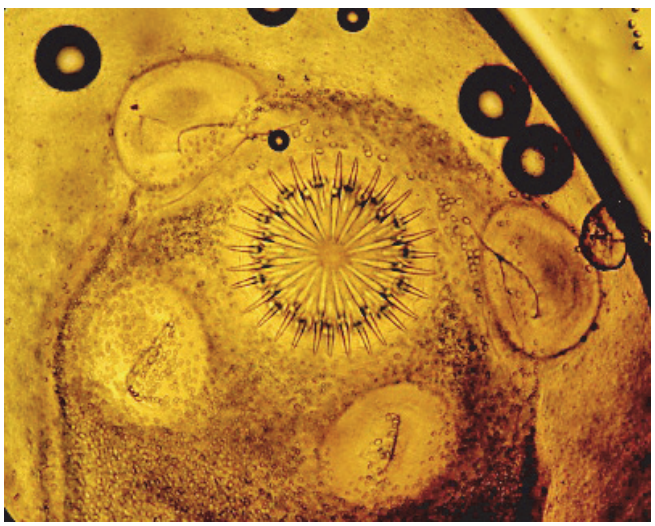

Fig. 3. Four suckers and rostellar hooks seen under optical microscope (G.X1800)

ones) distributed alternately. The others morphological criteria show significant differences ($p < 0.05$) between those of sheep and goats, namely: the length of the small hook blade, the length of the large hook blade, the length of the handle of the small hook and the length of the handle of the large hook.

Discussion

In developing countries, abattoirs play a major role in providing and serving as a source of information and references center for diseases prevalence (Wondimu et al., 2011). In this survey, 155 sheep (7.8%) and 263 goats (22.3%) was infected with *C. tenuicollis* cyst. Similar rate was reported by Al-Mayali (2005) in Iraq with 7.4% in sheep. Lower rates were reported by Rao et al. (2003) in Kakinada (Andhra Pradesh) with 2.36% and 1.62% in sheep and goats respectively. In Darmara region (Turkey), Öncel (2000) reported 2% and Radfar et al. (2005) recorded 18.04% in sheep. Though, higher prevalences were cited by Radfar et al (2005) with 12.87% in sheep in Iran and 27.29% in India (Pathak and Gaur, 1982). In Nigeria, a prevalence of 21.4% was found in sheep, and 34.2% in goats (Dada & Belino, 1978). In Ethiopia Samuel and Zewde (2010) found prevalence of 40% and 46.6% in sheep and goats, respectively. Sissay et al. (2008), in East Ethiopia with 79% and 53% in sheep and goats respectively.

The infection rate was higher in goats than in sheep. Our observation is in agreement with the findings of Radfar et al. (2005). They considered that grazing behavior and management are the major reasons for this. Similar result was reported in a study done by Wondimu et al. (2011), which suspected the close contact between dogs and goats.

According to Torgerson et al. (1998), under conditions of high infestation of *C. tenuicollis* most sheep develop protective immunity early in life and the density-dependent constraint regulates the parasite population. Whereas, goats develop the immunity more slowly.

In this study, the infection rate of *C. tenuicollis* was significantly higher in male than in female both in sheep and goats. The same result was obtained by Senlik (2008) in sheep, which was difficult to explain given the fact that both sexes were grazing on the same pastures and thus exposed to a similar challenge with *T. hydatigena* eggs.

The current study showed that the predominant predilection site of cyst in sheep (84.5%) was liver and in goats, omentum (41.4%) followed by liver (41%).

Many other studies revealed that these organs are the most infected, with variables rates; 62.7% and 58.2% in the omentum, 11.1% and 10.9% in the liver of goats and sheep, respectively (Wondimu et al., 2011), 46.5% and 39.8% in the omentum, 11.6% and 11% in liver of goats and sheep, respectively (Samuel and Zewde, 2010), 82.24% and 84.85% in omentum, 18.24% and 12.8% in liver of goats and sheep, respectively (Radfar et al., 2005).

In this study, different means and ranges in biochemical profiles analysed were noted. These, however are not statistically significant. Abidi et al. (1989) showed marked differences in the major of biochemical components of *T. hydatigena* and they concluded that the cyst of goat and pig origin probably represent different stains.

Our study revealed also that the large and small hooks of ovine and caprine protoscolex are arranged in two rows and alternately, with averages of 15 ± 1.12 and 14.9 ± 0.85 for large hooks of sheep and goats, respectively. Averages of 15.1 ± 0.72 and 15.1 ± 0.79 were found for small hooks of sheep and goats, respectively. Similar results have been reported by Radfar et al. (2005) with 15.33 ± 1.33 and 14.66 ± 0.5 for large hooks of sheep and goats, respectively. Averages of 15.44 ± 1.42 and 14.77 ± 0.66 were found for small hooks of sheep and goats, respectively. According to the present study, only the total number of hooks and the total length of the large and small hooks showed no significant difference between sheep and goats. The others morphological parameters studied showed significant differences for large and small hooks, namely the length of the blade and the length of the handle. The same result was reported by Radfar et al. (2005), concerning the length of the sleeve, the length of the guard and the total length of the small hooks, and which linked these significant differences to the existence of different subspecies of *T. hydatigena* in South-East Province, Iran.

From the above mentioned results, it could be concluded that *C. tenuicollis* is present in Tiaret region and that this may constitute economic and health problems in the meat industry. Goats represent a typical host reflected by higher infection rate as compared with sheep. In the morphology of the protoscolex of *C. tenuicollis*, it can be concluded that the large and small hooks of ovine or caprine protoscolex are arranged in two rows and alternately. Numerous biochemical and morphological parameters studies showed significant differences. These suggest the existence of different sub-species of *T. hydatigena* in the study area.

Appropriate control measures need to be introduced to reduce the prevalence of these parasites in small ruminants and careful condemnation of carcasses' offal's should properly carry out as well as control of stray dogs and further biomolecular studies are now required.

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