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RESEARCH OF MUSCULAR CYSTICERCOSIS IN MEAT INTENDED FOR HUMAN CONSUMPTION IN ALGIERS (ALGERIA)

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Abstract
Muscle cysticercosis is a foodborne parasitic zoonosecaused by infestation with cysts, larval forms of the *Taenia* tapeworm found in dogs and humans. The infection occurs through the consumption of raw or inadequatelycooked meat. The objective of this study was to determine the prevalence of infestation by this parasitic disease in sheep and cattle meat. A visual inspection was conducted on a total of 881 sheep carcasses and 264 cattle carcasses at the El-Harrach slaughterhouses. Infested sites were sampled, and the contents of the cysts were observed under an optical microscope. The infestation rate of cysticercosis was found to be 0% in cattle and 4.08% in sheep. Microscopic examination of the recovered live vesicles revealed the presence of cysts with two types of hooks. This study highlights the importance of controlling parasitic diseases, especially those transmitted to humans through meat consumption.

Keywords: cysticercosis, meat, slaughterhouses, hooks.

Introduction

Muscular cysticercosis (ladreries) refers to disorders of striated muscle tissue caused by the development of cysts which are the larval form of tapeworms known as *Taenia*. These parasites reside in the small intestine of various mammals, including humans (Porphyre, 2019). The definitive host for cysts of *Taenia saginata*, adult form of *Cysticercus bovis*, and *Taenia solium*, adult form of *Cysticercus cellulosae*, is humans who become infected by consuming poorly cooked or raw infected meat (Dorbek-Kolin et al., 2017; Abd El-Aziz et al., 2021). On the other hand, *Taenia ovis*, with its adult form of *Cysticercus ovis*, infects dogsas a definitive host (Hashemnia et al., 2016). In addition to the hygienic impact of cysticercosis through the transmission of zoonotic species to humans, the downgrading of carcasseswhich are subjected to refrigeration, and even their confiscation at slaughterhouses,inaddition to the cost of refrigeration and extra handling and transport lead to significant economic losses (Dewolfet al., 2012;Tolossa et al., 2015). The Mediterranean region, the Middle East, and Southwest Asia are considered high endemicity areas for cysticercosis infection (Dyab et al., 2017).

In Algeria, data published on muscular cysticercosis remains scarce. That is why our work was initiated to contribute to the research on this parasitic disease in sheep and cattle carcasses at El-

Harrach slaughterhouses. This was done based on conventional inspection followed by microscopic observation of the recovered vesicle content at the parasitology Laboratory of the High National Veterinary School of Algiers.

Material and methods

Sampling

During our various visits (60 visits) to the abattoirs of El-Harrach over a period of 5 months, a total of 264 bovine carcasses and 881 ovine carcasses, without distinction of breed, gender, or age, underwent traditional post-mortem inspection. Due to a lack of information and traceability, the exact origin of the animals is difficult to determine, but they generally belong to different farms from the central region of Algeria (Blida, Bouira, Médéa, etc.). Our working method relies on the traditional inspection of ovine and bovine carcasses at the abattoir. Sections showing suspicious lesions (cysts), especially on the diaphragm, heart, and oesophagus were sampled. In the laboratory, the lesions were categorized as dry or live, then opened using a scalpel blade to spread the contents of the parasitic cyst between a slide and a cover slip, and examined under an optical microscope at 10x and 40x magnifications.

Results and discussion

The lesions encountered during our study are documented in Table 1.

Table 1: Distribution of lesions according to species and organ.

Organ	**Cattle**		**Sheep**	
	V.C	**D.C**	**V.C**	**D.C**
Diaphragm	00	00	1	9
Heart	00	00	3	23
Oesophagus	00	00	0	1
Carcasses	00	00	3	33
Total	0/264 (0%)		36/881 (4.08 %)	

V.C: Viable cysts, D.C: Dry cysts

Bovine cysticercosis is a zoonotic parasitic disease transmitted to humans through the consumption of raw or undercooked meat. Out of the 264 inspected bovine carcasses, no cysticercosis lesions were detected (0%). Our results are similar to those observed in Poland by Kozłowska-Łój (2011), in Iran by Oryan et al. (2012) and Hashemnia et al. (2015), and in Estonia by Dorbek-Kolin et al. (2018). However, our results are lower than those reported by Kebede (2008), Firew et Moges (2014) and Tolossa et al. (2015) in Ethiopia, and Garedaghi et al. (2011) in Iran, who recorded cysticercosis infestation rates ranging from 2.6% to 18.49%.

The infestation rate recorded during this study, although seemingly reassuring, may not indicate the total absence of cysticercosis in bovine meat. This is because our inspection did not cover all selected territories (inaccessible tongue and masseter muscles due to the commercial presentation of the head in these abattoirs). Furthermore, bibliographic studies have shown that classical techniques for cysticercosis detection do not allow precise screening and miss a significant number of cases (Kebede, 2008).

On the other hand, the OIE manual (2021) indicates that the effectiveness of meat inspection varies depending of the number and location of incisions. Additionally, Dorbek-Kolin et al. (2018) reported the absence of visible cysts at the so-called preferred sites (heart, masseter, oesophagus, diaphragm, and tongue) in 49-51% of animals exhibiting mild infestation detected by dissection.

As regards the ovine species, several cases of cysticercosis lesions have been recorded in the heart, diaphragmand oesophagus. The number of infested ovine carcasses is 36 out of the 881 inspected, representing an infestation rate of approximately 4.08%. This rate is higher than those reported by Oryan et al. (2012), Hashemnia et al. (2016), Dyab et al. (2017) and Hajipour et al. (2020), which

ranged from 0.09% to 2.9%. Furthermore, our results are substantially lower than those reported by Abd El-Aziz et al. (2021) and DeWolf et al. (2012), who detectedmuscular cysticercosis, respectively, in 32.14% and 48.4% of the inspected ovine carcasses.

The myocardium was the most affected muscle with a rate of 69%, followed by the diaphragm (28%), and finally the oesophagus (3%). The bibliographic data supports our findings. Thus, Kebede (2008), Hashemnia et al. (2016), Dyab et al. (2017), and Hajipour et al. (2020) have reported that the myocardium is the most affected muscle in cysticercosis. The distribution of lesions in different organs could be influenced by several factors such as muscle activity, age, and geographical location (Tolossa et al., 2015).

The scarcity of data regarding ovine cysticercosis may be explained by the fact that the adult stage (*Taenia ovis*) of *Cysticercus ovis* develops in dogs (dog-sheep cycle), excluding it from the list of zoonotic diseases. However, some data have reported individual cases of human infection with *Cysticercus ovis,* presenting localized lesions in the spinal cord (Acha and Szyfres, 2005). Porphyre (2019) also reported that humans could rarely be affected by the larval stages of cat and dog tapeworms, including *C. ovis*.

Microscopic observation of the infective vesicles has shown the existence of two forms of hooks, the comparison of which, according to the table elaborated by Euzeby (1998), leads us to believe that they belong to two different species. The form represented in Figure 1 shows hooks with a handle larger than the blade, resembling the shape of a *Cysticercus ovis,* while the second form (figure 2) is distinguished by hooks with handles shorter than the blade, suggesting that it belongs to another species, possibly *Cysticercus cellulosae* larva of *Taenia solium*, with humans as the definitive host (zoonotic species). This finding is not surprising when considering the data reported by Acha and Szyfres (2005), who reported the "exceptional" possibility of ovine infestation by *C. cellulosae.*

Table 2: Comparative table between *C. cellulosae* and *C. ovis* (Euzeby, 1998).

	C. cellulosae	***C. ovis***
Number of hooks	22 to 32 (32)	24 to 34 (29)
Form of hooks	The handle is at most equal to the blade, and the guard forms an obtuse angle with the blade (dagger-like shape).	The handle is longer than the blade, and the guard forms a right angle with the handle and the blade.

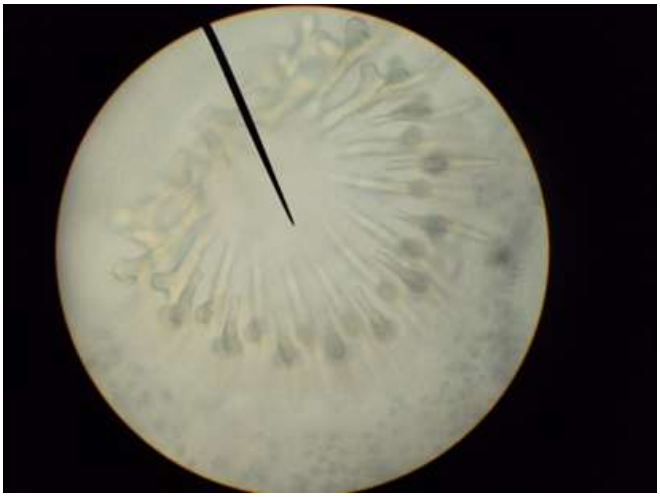

Fig.1: Hooks of the presumed species *Cysticercus ovis* observed under an optical microscope (40x magnification).

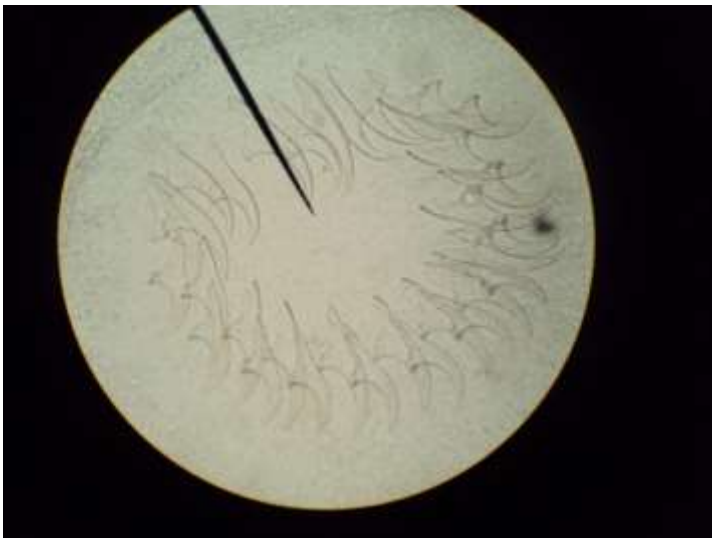

Fig.2: Hooks of the presumed species *Cysticercus cellulosae* observed under an optical microscope (40x magnification).

Conclusion

This study revealed the presence of cysticercosis lesions on sheep carcasses. The disease leads to financial losses due to the seizure of infested organs and parts, as well as the downgrading of carcasses. Therefore, strict measures should be implemented for the control of this parasitic disease, as well as for raising consumer awareness about disease transmission methods in order to preserve human and animal health. Furthermore, the microscopic observation of two different aspects of *Cysticercus* hooks has brought back the hypothesis of accidental infestation of sheep by species other than *Cysticercus ovis.* However, drawing definitive conclusions from this very limited observation would be risky. Therefore, further in-depth studies should be conducted on a larger scale.

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