Prevalence and Distribution of Sarcocystis in Buffaloes and Sheep in Egypt

Reda A. Gerab, Abo-Bakr M. Edris, Hanan M. Lamada, Amina Mohamed Elrais

INTRODUCTION

Buffaloes (Bubalus bubalis) are reared in Middle Eastern countries, particularly in Egypt for the purpose of meat and milk production. Buffaloes’ meat can provide humans with part of their needs of essential amino acids, minerals, and vitamins. However, buffaloes’ meat might act as a considerable source for transmission of foodborne pathogens to humans such as several bacterial and parasitic species.

Sarcocystosis is a parasitic zoonosis distributed all over the world caused by Sarcocystis species which are apicomplexan parasites requiring intermediate and definitive hosts to complete their life cycle, inside the intermediate host occurs the asexual life cycle with cysts formation called Sarcocystis, while the sexual life cycle occurs inside the definitive host. Final hosts including carnivores and humans usually become infected by ingestion of undercooked meat containing Sarcocystis, while intermediate hosts become infected by ingestion of sporulated oocysts or sporocysts in contaminated food or water (Dubey et al., 2015).

Buffaloes are intermediate hosts for some species of Sarcocystis; they may harbour macroscopic or microscopic Sarcocystis in their striated muscles (Dubey and Lindsay, 2006). Buffaloes (Bubalus bubalis) are natural intermediate hosts for four species of Sarcocystis including S. fusiformis and S. buffalonis with felids as the final host, S. levinei with canids as the final host and S. dubejyi with an unidentified final host (Hilali et al., 2011).

Sheep act as intermediate hosts for 6 Sarcocystis species including S. gigantea, S. medusiformis, S. tenella, S. arieticanis, S. microps, and S. miihoensis, which can be morphologically differentiated by variations in the ultrastructure of the sarcocyst wall. Sarcocysts of S. tenella and S. arieticanis are microscopic sarcocysts and transmitted by canine final hosts, whereas S. gigantea and S. medusiformis form macroscopic sarcocysts and are transmitted by cats (Dubey et al., 2015).

The genus Sarcocystis contains more than 200 species characterized by a worldwide geographic distribution. Three species of Sarcocystis including S. hominis, S. heydorni, and S. suihominis are known to use humans as the final host. Humans become infected by ingesting sarcocysts in muscular tissues of intermediate hosts, while the intermediate hosts are infected by ingesting sporulated oocysts or sporocysts in contaminated food or water. Two different clinical forms of sarcocystosis in humans: an intestinal form, caused by S. hominis, S. heydorni and S. suihominis, and a muscular form, caused by S. neosbitti, the only Sarcocystis species that uses humans as intermediate host (Dubey et al., 2015).

In Egypt, buffaloes’ meat is a major meat supply in the Egyptian market where males are only slaughtered, and there is a strict law prohibits slaughtering of female buffaloes unless become out of the production cycle. The prevalence of Sarcocystis spp. in buffaloes’ meat of both sexes in Egypt is less investigated.

Moreover, mutton represents an essential source of animal protein for human and contributes considerably in the Egyptian diet of Veterinary Medicine, Benha University, Egypt.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

ISSN: 2090-6277/2090-6269/ © 2011-2022 Journal of Advanced Veterinary Research. All rights reserved.
food security.

In sight of the previous facts, the present study was conducted to investigate the prevalence of sarcocysts in slaughtered buffaloes and sheep macroscopically and microscopically. Besides, some associated risk factors (age and sex) were assessed. Additionally, organ distribution of microscopic sarcocysts in slaughtered buffaloes and sheep using was discussed.

MATERIALS AND METHODS

This study was conducted according to the guidelines of Benha University for the use of animals, where no living animals were used in the current investigation.

Study animals

A total number of 200 slaughtered buffaloes (100 young males and 100 old females) and 200 slaughtered sheep (100 young males and 100 old females) were examined for detection of macroscopic and microscopic sarcocysts during the period from July 2020 to June 2021 at Tanta abattoir, Egypt. Each animal was identified by sex (male-female) and by age (young-old). The age of investigated animals was assessed by visual inspection of teeth.

Gross examination

Macroscopic sarcocysts were identified by visual inspection of muscular tissues according to Huong (1999). Muscle masses from the oesophagus, heart, tongue, masseter muscle and skeletal muscle were sliced to facilitate gross inspection to detect any macroscopic sarcocysts in slaughtered buffaloes and sheep. Also, the percentage of positive and negative macroscopic sarcocysts was recorded for both species.

Samples collection

Fresh samples from the oesophagus, tongue, heart, masseter muscle and skeletal muscle were collected from slaughtered buffaloes and sheep to determine the prevalence of microscopic sarcocysts. All samples were labelled and immediately fixed in 10% neutral buffered formalin for further histological examination at Department of Pathology, Faculty of Veterinary Medicine, Kafrelshiekh University, Egypt.

Histological examination

Samples were fixed in 10% neutral buffered formalin and processed for histological technique according to Bancroft and Gamble (2008) through dehydration in graded ethanol, embedded in paraffin wax, sectioned at 5 µm in thickness and stained by Hematoxylin and Eosin (H&E). The slides were visually screened for microscopic sarcocysts by highly experienced staff at Department of Pathology, Faculty of Veterinary Medicine, Kafrelshiekh University. All results were photographed by a digital camera.

RESULTS

A total of 200 buffalo carcasses and 200 sheep carcasses were examined in Tanta abattoir, Egypt for detection of sarcocysts during the period from July 2020 to June 2021. The results in Table 1, revealed that the prevalence of macroscopic sarcocysts was 26.5% in slaughtered buffaloes (42% in females and 11% in males) and 80.5% in slaughtered sheep (93% in females and 68% in males). Moreover, the results in Tables 1 and 2, revealed a higher prevalence of sarcocysts in old buffaloes (42% macroscopic sarcocysts and 79% microscopic sarcocysts) than in young buffaloes (11% macroscopic sarcocysts and 33% microscopic sarcocysts) and a higher prevalence of microscopic sarcocysts in old sheep (93%) than in young sheep (68%).

<table>
<thead>
<tr>
<th>Species</th>
<th>Age Group</th>
<th>Sex</th>
<th>Examined Number</th>
<th>Positive Number</th>
<th>Prevalence %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffaloes</td>
<td>1-3 years</td>
<td>Male</td>
<td>100</td>
<td>33</td>
<td>33%</td>
</tr>
<tr>
<td></td>
<td>5-8 years</td>
<td>Female</td>
<td>100</td>
<td>79</td>
<td>79%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>200</td>
<td>112</td>
<td>56%</td>
</tr>
<tr>
<td>Sheep</td>
<td>1-2 years</td>
<td>Male</td>
<td>100</td>
<td>68</td>
<td>68%</td>
</tr>
<tr>
<td></td>
<td>3-5 years</td>
<td>Female</td>
<td>100</td>
<td>93</td>
<td>93%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>200</td>
<td>161</td>
<td>80.50%</td>
</tr>
</tbody>
</table>

Table 1. The prevalence of macroscopic sarcocysts in slaughtered buffaloes and sheep concerning age and sex.

Fig.1. Macroscopic appearance of sarcocysts isolated from an infected buffalo’s oesophagus.

Table 2. The prevalence of microscopic sarcocysts in slaughtered buffaloes and sheep concerning age and sex.

Fig. 2. Histological section representing a microscopic sarcocyst isolated from an infected buffalo’s tongue. The sarcocyst initiated no tissue reaction (H&E stain).
The results in Tables 3 and 4, demonstrated that the most affected organs with microscopic sarcocysts were the oesophagus (53.5% in buffaloes and 76% in sheep) followed by the tongue (45.5% in buffaloes and 70% in sheep), masseter muscle (41% in buffaloes and 53% in sheep), skeletal muscles (32% in buffaloes and 48.5% in sheep) and finally the heart (24% in buffaloes and 38.5% in sheep).

**DISCUSSION**

Concerning prevalence of macroscopic sarcocysts in slaughtered buffaloes and sheep, the results in Table 1, revealed that the prevalence of macroscopic sarcocysts in slaughtered buffaloes was 26.5%. Nearly, the same results were recorded in Egypt by Metwally et al. (2014) who recorded 25.5%, Aziz et al. (2017) recorded 26.9%, Mousa et al. (2016) recorded 23.6%, Youssef et al. (2013) recorded 20.33% and Nahed et al. (2014) recorded 30.9%. In other countries, Hamidinejat et al. (2009) recorded 20% in Iran and Jyothisree et al. (2017) recorded 22.62% in India. On the other hand, this result (26.5%) disagreed with the higher prevalence of macroscopic sarcocysts in buffaloes reported in Egypt by El-Bahy et al. (2019) who recorded 85.96%, El Shanawany et al. (2019) recorded 74% and Mousa et al. (2021) recorded 47.24%. In addition, this result (26.5%) disagreed with the lower prevalence of macroscopic sarcocysts in buffaloes reported in Egypt by Hussein et al. (2017) who recorded 3.9%, Ahmed et al. (2016) recorded 8.33%, Dyab et al. (2019) recorded 12% and El-Dakhly et al. (2011) recorded 6.9%. In other countries, Nicolas et al. (2019) recorded 4.93% in the Philippines and Oryan et al. (2010) recorded 3% in Iran.

Concerning prevalence of macroscopic sarcocysts in slaughtered sheep, the results in Table 1, revealed that the prevalence of macroscopic sarcocysts in slaughtered sheep was 0%. Nearly, the same results were recorded by El-Morsey et al. (2019) who recorded 0% in El-Mahalla El-Kubra, Egypt, Hussein (2020) recorded 0% in Qena, Egypt, Bittencourt et al. (2016) recorded 0% in Brazil, Abdullah (2021) recorded 0% in Iraq, Dong et al. (2018) recorded 0% in China, Januskevicius et al. (2019) recorded 0% in China.
in Lithuania, Mekibib et al. (2019) recorded 0% in Ethiopia. This result (0%) disagreed with El-Morsy et al. (2021) who recorded 13.20% in Egypt, Mahran (2009) recorded 9.9% in Shalatin, Egypt, Beyazit et al. (2007) recorded 24.5% in Turkey, Mirzaei Dehagh et al. (2013) recorded 6% in Iran, Martinez-Navalon et al. (2012) recorded 12% in Spain, Pipia et al. (2016) recorded 23.3% in Italy, Minuzzi et al. (2019) recorded 7.7% in Brazil, Phythian et al. (2018) recorded 14.3% in Tasmanian sheep in Australia.

In the present study, the prevalence of microscopic sarcocysts in slaughtered buffaloes was 56%. Nearly, the same results were recorded by Aziz et al. (2017) who recorded 52.4% using the histopathological method in Sohag, Egypt, Mousa et al. (2017) recorded 48.36% in Dakahlia province, Egypt, Ramakrishna et al. (2017) recorded 60.78% in India, Hadadzadeh et al. (2004) recorded 53.5% in Iran and Hamidinejat et al. (2009) recorded 57% using digestion method and 54% using dob smear in Iran. This result (56%) disagreed with the lower prevalence of microscopic sarcocysts in slaughtered buffaloes obtained by Metwally et al. (2014) who recorded 27.7% in Assiut, Egypt, Mousa et al. (2016) recorded 20% in frozen buffalo meat in Alexandria, Egypt and Portella et al. (2021) recorded 23.75% in Brazil. Additionally, this result (56%) disagreed with the higher prevalence of microscopic sarcocysts in slaughtered buffaloes obtained by El-Dakhly et al. (2011) who recorded 78.9% in Beni-Suef, Egypt, Mousa et al. (2021) recorded 86% in Sirs-Elian, Egypt, Dar et al. (2017) recorded 95.5% in India, Oryan et al. (2010) recorded 83% in Iran and Latif et al. (1999) who recorded 82.9% using peptic digestion method in Iraq.

The prevalence of microscopic sarcocysts in the investigated sheep was 80.5%. Nearly, the same results were recorded by El-Sheikh et al. (2018) who recorded 95% in Kebira, Egypt, Hussein et al. (2018) recorded 75.96% in Qena, Egypt, Beyazit et al. (2007) recorded 86.5% in Turkey, Pipia et al. (2016) recorded 77.7% in Italy, Latif et al. (2015) recorded 86% in Malaysia and Benenji et al. (2019) recorded 81.90% in Iran. This result (80.5%) disagreed with the lower prevalence of microscopic sarcocysts in slaughtered sheep obtained by Mahran (2009) who recorded 41.26% in Shalatin, Egypt, Hussein (2020) recorded 47.27% in Qena, Egypt, Ozkayhan et al. (2007) recorded 47.32% in Turkey and Dong et al. (2018) recorded 52.51% in China. This result (80.5%) disagreed with the higher prevalence of microscopic sarcocysts in slaughtered sheep recorded by Mirzaei Dehaghi et al. (2013) who recorded 100% in Iran, Januskevicius et al. (2019) recorded 100% in Lithuania, Paranid et al. (2015) recorded 100% in Iran, Fukuyo et al. (2002) recorded 96.9% in Mongolia and Minuzzi et al. (2019) recorded 96.1% in Brazil. The difference in prevalence rates may be due to the different methods of diagnosis, different localities, and different management practices (Aziz et al., 2017). The obtained results confirmed that Egyptian buffaloes are infected with Sarcocysts due to the abundance of final hosts especially dogs and cats that encourage the spreading of infection by this protozoon. Moreover, most of the Egyptian abattoirs do not have total security from the entry of stray dogs and hosts especially dogs and cats that encourage the spreading of Toxoplasma gondii which results in sarcocysts accumulation gradually inside muscles (Taib et al., 2016).

The results in Table 2, revealed a higher prevalence of microscopic sarcocysts in old sheep (93%) than in young sheep (68%). Nearly, the same results were recorded by Abuelwafa et al. (2016) who recorded a higher prevalence of microscopic sarcocysts in old sheep (98.5%) than in young sheep (86.57%) in Lakha province, Egypt, Hussein (2020) recorded a higher prevalence of microscopic sarcocysts in old sheep (59.42%) than young sheep (26.82%) in Qena, Egypt, Ibrahim et al. (2018) recorded a higher prevalence of microscopic sarcocysts in old sheep (27.2%) than young sheep (17.8%) in Cairo, Egypt and Ozkayhan et al. (2007) who recorded a higher prevalence of microscopic sarcocysts in old sheep (59.25%) than young sheep (16.12%) in Turkey.

Concerning organ distribution of sarcocysts in slaughtered buffaloes, the most infected organ with microsarcocysts was the oesophagus (53.5%) followed by the tongue (45.5%), masseter muscle (41%), skeletal muscle (32%) and the least infected organ was the heart (24%). Nearly, the same results were recorded by El-Dakhly et al. (2011) who recorded the highest prevalence of microsarcocysts in the oesophagus (74.1% in old buffaloes and 68% in young buffaloes) followed by the tongue (15.3% in old buffaloes and 6.5% in young buffaloes) and the least prevalence in the heart (7.1% in old buffaloes and 3.9% in young buffaloes) using the histological method in Beni-Suef, Egypt, Jyothsree et al. (2017) recorded the highest prevalence of microsarcocysts in the oesophagus (51.82%) followed by the tongue (47.44%) and heart (29.92%) in India, Nahed et al. (2014) recorded the highest prevalence of microsarcocysts in the oesophagus (68.96%) in Egypt and Ibrahim et al. (2018) recorded the highest prevalence of sarcocysts in the oesophagus followed by the tongue and finally the heart. On the contrary, Oryan et al. (2010) recorded the highest prevalence of microsarcocysts in masseter muscle (5%) followed by the tongue (44%) in Iran, Latif et al. (2013) recorded the highest prevalence of microsarcocysts in the heart (66.7%) followed by oesophagus (50%) in Malaysia, Dar et al. (2017) recorded that the tongue was the most infected organ by microsarcocysts (87.40%) followed by oesophagus (83.60%) in India and Mousa et al. (2021) that the tongue was the most infected organ.
infected organ by microsarcocysts (46%) in Sirs-ElIian, Egypt.

Furthermore, the most infected organ with microsarcocysts in sheep was the oesophagus (76%) followed by the tongue (70%), masseter muscle (53%), skeletal muscle (48.5%) and the least infected organ was the heart (38.5%). Nearly, the same results were obtained by Nageib and kuraa (2018) who recorded the highest prevalence of microscopic sarcocysts in the oesophagus (71%) in Assiut, Egypt, El-Morsy et al. (2019) recorded the highest prevalence of microscopic sarcocysts in the oesophagus (62.3%) in Egypt, Hu et al. (2017) recorded the highest prevalence of microscopic sarcocysts in the oesophagus (84.9%) in China and Abdullah (2021) recorded the highest prevalence of microscopic sarcocysts in the oesophagus (95%) in Iraq. In contrast, Bitten court et al. (2016) recorded that tongue was the most infected organ (86.7%) using the squash method in Brazil, Fukuyo et al. (2002) recorded that tongue was the most infected organ (100%) in Mongolia, Latif et al. (2015) recorded that skeletal muscle was the most infected organ (64.9%) in Malaysia.

CONCLUSION

This study reports the presence of Sarcocystis species in buffaloes and sheep slaughtered at Tanta abattoir, Egypt. Therefore, meat should be cooked thoroughly or frozen before usage to prevent zoonotic foodborne transmission into human consumers. The obtained results confirmed that Egyptian buffaloes and sheep are infected with Sarcocystis species due to the abundance of final hosts, especially dogs and cats that encourage the spreading of infection by this protozoan. Strict control measures should be applied to stray dogs and cats in developing countries especially Egypt, as they play serious roles in transmitting infection with different species of Sarcocystis to buffaloes and sheep. Therefore, the concerned authority should make efforts for proper meat inspection procedures and combat street dogs and cats.

ACKNOWLEDGMENTS

The authors would like to express their gratitude to the veterinary practitioners and all workers of Tanta Abattoir for their allowance and help to collect meat specimens.

CONFLICT OF INTEREST

Authors declare that there is no conflict of interest.

REFERENCES


Berenji, F., Yazicioğlu, Ö., Karaer, Z., 2007. The prevalence of ovine Sarco-


ic and molecular identification of three macroscopic Sarcocystis species infecting domestic sheep (Ovis aries) and cattle (Bos taurus) in Egypt. Parasitology Research 120, 637-654.


Hu, J.-J., Huang, S., Wen, T., Esch, G.W., Liang, Y., Li, H.-L., 2017. Sarcocystis spp. in domestic sheep in Kuming City, China: prevalence, mor-
phology, and molecular characteristics. Parasite 24, 30.


Hussein, N.M., Hassan, A.A., Abd Ella, O.H., 2018. Morphological, ultra-
structural, and molecular characterization of Sarcocystis tenella from sheep in Qena governorate, upper Egypt. Egyptian Aca-
ademical Journal of Biological Sciences, E. Medical Entomology and Parasitology 10, 11-19.


