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Research Article

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A Slaughterhouse Study on the Prevalence and Direct Economic Losses of Liver Parasites in the Sheep of Birjand City

Ali Karimi[1*], Reza Farahmand Rad[2]

[1]Department of Parasitology, Kazerun Branch, Islamic Azad University, Kazerun, Iran
[2]Graduate Student of Kazerun Branch, Islamic Azad University, Kazerun, Iran

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Abstract

Background and aim: Liver parasites are one of the most important parasitic groups which, in addition to causing diseases in host animals, also have zoonotic importance. This study was conducted with the aim of examining the livers of sheep slaughtered in the industrial slaughterhouse of Birjand city and identifying the parasitic contamination in them, finding the cause of contamination and estimating the direct economic losses caused by them.
Materials and Methods: The present study was descriptive-analytical and it was conducted cross-sectionally in four seasons of spring, summer, autumn and winter of 2021. During the research period, by referring to the slaughterhouse, the removed livers were collected and transferred to the parasitology laboratory in cold condition and on ice bags. In the laboratory, the possible cysts in the liver were subjected to diagnostic examinations by examining the appearance and also making deep cuts in the liver tissue.
Results: During the 12-month research period, 15319 sheep were slaughtered, among which 790 sheep had parasitic infections in their livers. Infected livers were removed wholly or partially. The total number of liver removals caused by parasites was estimated at 793 kilograms, which is based on the daily price (per kilogram of liver: one million and five hundred Rials) and it was calculated as one billion one hundred eighty-nine million five hundred thousand Rials (1189500000 Rials). The parasites observed in the infected livers included hydatid cyst, Fasciola, Dicrocelium, Cysticercus tenuicollis and Sarcocyst.
Conclusion: Considering the extent and volume of contamination and taking into account the direct financial loss caused by parasitic contamination in Birjand city, it could be estimated that parasites cause huge and significant amounts of damage to the country's animal husbandry industry every year.

Keywords: *Liver parasites, Sheep, Economic damage, Birjand*

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**** Corresponding Author***
Department of Parasitology, Kazerun Branch, Islamic Azad University, Kazerun, Iran.
E-mail: alikarimi224@yahoo.com, Orcid: https://orcid.org/0000-0002-8773-8782

Introduction

In Iran and most of the countries of the world, liver parasites are one of the most important parasitic groups, which, in addition to causing disease in animal hosts, also have zoonotic significance. Among the most important parasites found in the liver of animals and humans are tapeworm metacestode, especially hydatid cysts, trematodes such as Fasciola and Dicrocelium, and protozoa such as Sarcocyst and Toxoplasma. The presence of the mentioned parasites in the liver and bile ducts causes partial or complete confiscation of the liver of animals in the slaughterhouse, which naturally causes direct economic losses to the country's animal husbandry industry. In addition to the mentioned direct damages, liver parasites also indirectly cause damage to infected animals and therefore indirect economic damages (Daryani *et al.,* 2007; Moghaddam *et al.,* 2004; Oryan *et al.,* 2011).

The most important of these indirect damages are anemia, reduction of blood proteins, weakness of the immune system, reduction of minerals and micronutrients, loss of appetite, reduction of fertility, etc. that the sum of the mentioned indirect damages which ultimately cause a reduction in production are far higher than the direct economic damages caused by confiscation of infected livers. The decrease in livestock production, in addition to the economic losses it causes to the society, causes a decrease in the consumption of meat and meat products, and as a result, the members of the society suffer from food poverty and diseases caused by it. Small ruminants, especially sheep, have a high place in our animal husbandry and food basket in terms of their number, as well as our Iranian food and cultural habits (Dalimi *et al.,* 2002).

Iran's sheep population is more than 50 million heads, most of them are bred in traditional ways, and for this reason, every year a large number of them are infected with parasitic infections, especially liver parasites. Slaughterhouse studies are a method in epidemiologic studies of parasitology that provide almost complete and comprehensive information about the amount of parasitic infections. Because firstly, the most important and most abundant parasites, especially liver parasites (Fasciola, Dicrocelium and hydatid cyst) are large in size and can be detected with the naked eye in a slaughterhouse inspection. Secondly, due to the nature of the mentioned parasites and the geographical and climatic conditions of our country, the diseases caused by them are often subclinical and chronic and do not have clear clinical symptoms, so for the two reasons mentioned in this study, the slaughterhouse method was used (Rokni, 2009; Khanjari *et al.,* 2014).

One of the common parasitic diseases between humans and animals is hydatidosis, which causes disability and even death in humans in addition to the economic losses it causes to the country's animal husbandry industry. This disease has spread worldwide and Iran is one of its centers, as it is prevalent in most of the provinces of the country. As the intermediate host of Echinococcus granulosus, sheep play a more important role than other intermediate hosts in the life cycle of this parasite (Rokni, 2009; Dalimi *et al.,* 2002).

The economic losses caused by the confiscation of parasite-infected organs in Iran amount to billions of Rials annually. In Turkey, it has been reported that hydatid cyst infection brings an average economic loss of 3.2 dollars in a sheep and 7.5 dollars in a cow. Also, in Turkey, according to a slaughterhouse investigation, 48.35 percent of slaughtered sheep`s livers were infected with hydatid cysts (Umur, 2003).

The rate of contamination of Tabriz sheep's liver with hydatid cyst is reported as 23.57 percent (Movassagh Ghazani *et al.,* 2008). Economic losses caused by hydatid cyst contamination are very significant, especially in developing countries (Torgerson *et al.,* 2001). According to the survey conducted in Isfahan slaughterhouse, 3.47 of sheep's livers were infected with hydatid cysts, and 78 percent of the cysts were fertile by microscopic examination (Hosseini Safa *et al.,* 2014).

In general, hydatidosis is a common disease in Middle Eastern countries, especially neighboring countries of Iran. In Iraq, the prevalence of hydatidosis in sheep has been reported as 4.5-44% and in Bezan 26.7-3.1% (Molan 1993; Saeed *et al.,* 2000). In Turkey, 26.6% of sheep and 22.1% of goats were infected with hydatid cysts (Umur, 2003). In Kuwait, 11.2% - 0.2% of sheep and 5% of goats had hydatidosis infection (Hassounah & Behbehani, 1976). In Pakistan, 8.3% of sheep and 7.5% of goats were infected (Khan & Haseeb, 1984). The prevalence of hydatidosis in Indian sheep was

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93.3%-2.3% and in Bezan 72.7%-1.1% (Islam, 1981). In Syria, the rate of hydatidosis in sheep was 4.5% and 2.3% in goats (Dajani, 1978).

In addition to the studies conducted on sheep liver hydatid cysts, examples of which were mentioned above, studies on sheep liver infection with other parasites, especially Fasciola and Dicrocelium trematodes, have been conducted in the country, which indicates their high prevalence. And in the following, we examine some examples of these studies: According to a slaughterhouse survey conducted in Amol city (Mazandaran province), the contamination rate of the livers of sheep and goats slaughtered in the slaughterhouse with Fasciola and Dicrocelium flukes is 6.6 and 4.3 percent, respectively (Khanjari *et al.,* 2014). In general, it can be said that fasciolosis is an endemic disease in most regions of our country and it has been reported in many provinces including Kurdistan, Zanjan, Kermanshah, Mazandaran, Tehran, Azerbaijan, Gilan, Fars and Khuzestan (Amor *et al.,* 2011). Liver infection with Dicrocelium is also very common in Iran's livestock, although it is less in terms of prevalence and pathogenicity than Fasciola, but due to the slaughterhouse removal of the infected organ (liver), it naturally causes economic loss (Ahmadi *et al.,* 2010). An important point is that all livers infected with Dicrocelium are recorded in the slaughterhouse.

One of the important duties of our veterinarians is to control, prevent and raise awareness about common diseases between humans and animals. In this regard, sheep are of special importance due to the major role they play in the food cycle of humans, for this reason, extensive studies in especially sheep parasites have been done around the world but in Iran, such studies and investigations have been limited and ad hoc, which mainly included investigations of the prevalence of sheep parasites, and the investigation of the effects and economic losses caused by them has been very limited. Therefore, the present research aims to investigate liver parasites in sheep slaughterhouses. Birjand city estimated the direct economic losses caused by confiscating infected livers.

Materials and Methods

The present study is descriptive and analytical and cross-sectional in Birjand city, the capital of South Khorasan province, with the aim of investigating the prevalence of liver parasites in sheep slaughtered in the slaughterhouse in the spring, summer, autumn and winter seasons from April to March 1400 was done. During the research period, by referring to the slaughterhouse, the removed livers were collected and transported to the parasitology laboratory in cold conditions and on ice bags. In the laboratory, the possible cysts in the liver were subjected to diagnostic examinations by examining the appearance and also deep cuts in the liver tissue (Figure 1, 2 and 3).

For example, parasitological diagnosis was made by characteristics such as: the color of the cyst fluid, the presence of hydatid sand, the presence of protoscolex, the thickness of the cyst wall, the color of the cyst wall, and the presence of calcareous salts in the cyst. Also, the liver tissue was cut to a thickness of 2 to 3 cm so that the bile ducts were also cut and exposed, then the possible samples of Fasciola were taken with helminthological sampling needles and kept in the alcohol formalin solution of glacial acetic acid (A.F.A).

Then the liver pieces were placed in a bucket full of water for 12 hours so that the remaining parasite samples float on the surface of the water. The pieces of the liver were taken out of the water and pressed by hand to remove the parasites that are in the deep bile ducts. At the end, after removing the liver pieces, the remaining liquid was passed through a 100 mesh sieve to collect Dicrocelium trematodes. In each sampling, the number and weight of the seized livers due to parasitic contamination were recorded and the direct economic damage caused by their seizure was calculated based on the daily price.

Results

In the period of one year, a research was conducted from April to March 1400 on 15319 sheep carcasses slaughtered in the industrial slaughterhouse of Birjand city. Among the carcasses, 790 livers infected with parasites were detected, which were as follows in terms of the type and percentage of contamination:

Hydatid cyst (Figure 4 and Figure 5) 51.51 percent
Dicrocelium (Figure 6) 26.96 percent
Fasciola (Figure 7 and Figure 8) 10.63 percent
Sarcocyst (Figure 9) 4.05 percent
Cysticercus tenuicollis 6.85 percent

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The table below (Table 1) shows the type and percentage of parasitic infection according to the number of infected livers (790) and the total number of slaughtered animals (15,319 heads):

Type of parasitic infection	Number of infected livers	The percentage of specific contamination to total parasitic contamination	The percentage of contamination in all slaughtered animals
Hydatid cyst	407	51.51	2.65
Fasciola	84	10.63	0.54
Dicrocelium	213	26.96	1.39
Sarcocyst	32	4.05	0.2
Cysticercus tenuicollis	54	6.83	0.35

Table 1. The type and percentage of parasitic infection of sheep livers.

Below are some pictures of the slaughterhouse and infected livers:

Figure 1. Livestock slaughter line in Birjand industrial slaughterhouse.

Figure 2. Visual inspection was done with incisions in the liver tissue and bile ducts.

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Figure 3. Visual inspection was done with incisions in the liver tissue and bile ducts.

Figure 4. Liver infected with hydatid cysts.

Figure 5. Hydatid cysts in the liver.

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Figure 6. Dicrocelium trematode (needle trematode with small millimeter size).

Figure 7. Fasciola in the liver.

Figure 8. Fasciola isolated from liver.

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Figure 9. Macroscopic Sarcocystis (they were brass-shaped and about one millimeter long).

Discussion

In the present study, out of 15319 slaughtered sheep in Birjand industrial slaughterhouse, 790 livers were identified with parasitic infections, and the share of hydatid cysts among these infections was 51.51 percent and the share of this infection compared to all examined livers. Both healthy and unhealthy were equal to 2.65 percent.

Arbabi and Hoshiar reported the prevalence of hydatid cyst infection in slaughtered animals as 2.7 percent while investigating the prevalence of hydatidosis in Kashan city (Arbabi & Hoshiar, 2006). Sharifi estimated the amount of liver contamination of slaughtered sheep in Kerman slaughterhouse to be 9.2 percent (Sharifi, 1996). Fallah et al., declared the amount of infected livers of sheep slaughtered in Hamadan slaughterhouse to be 10.6 percent (Fallah *et al.,* 2002). The amount of liver hydatidosis in sheep slaughtered in the slaughterhouses of North Khorasan (Rokni, 2009), western regions of Iran (Dalimi *et al.,* 2002), Kurdistan (Rokni, 2009), Ardabil (Daryani *et al.,* 2007) and Qom (Fakhar & Sajjadi, 2007) respectively, is 20.6 percent, 11.1 percent, 51.9 percent, 74.4 percent, and 9.3 percent were reported. As can be seen, the most hydatid infection Sheep belongs to Ardabil city.

The results of the present research on the degree of liver infection with hydatid cyst are almost similar to the results reported in Kashan city. According to the present study, hydatid cyst has caused the removal of about 410 kilograms of liver, equivalent to about 610 million Rials (at the price of 1400), in sheep slaughtered in Birjand industrial slaughterhouse.

In a study conducted in 2004 in the slaughterhouse of Amol city, the rate of infection of sheep's liver with Fasciola was 5.8 percent (Moghaddam *et al.,* 2004). On the other hand, Oryan et al., reported the rate of Fasciola infection in sheep as 0.35 percent during the surveys they conducted in the northeastern regions of Iran (Oryan *et al.,* 2011).

The prevalence of fasciolosis infection is higher in humid and rainy areas. Areas that provide suitable biological conditions for the reproduction of intermediate host snails are important in the frequency of Fasciola infection. This is the reason why the provinces along the Caspian Sea are generally more important in terms of the abundance of Fasciola than other regions of the country (Relf *et al.,* 2011; Issia *et al.,* 2009).

In general, the prevalence of Fasciola in Birjand city is less than in most regions of the country, which is due to the hot and dry climatic conditions of the city, as mentioned above. In the present study, the share of Fascioliasis among liver infections in the liver of slaughtered sheep in Birjand industrial slaughterhouse was 10.63%, which caused the removal of about 84.35 kilograms of liver and caused

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direct economic damage in the amount of 126529790 Rials became.

In the present study, the share of Dicrocoeliasis among liver parasitic infections was 26.96% and the share of this parasitic infection in the liver was 1.39% compared to all examined livers, both healthy and unhealthy. Dicrocoeliasis is one of the parasitic infections that can be found in most regions of the country, and snails and ants play an important role in its geographical distribution. Since the clinical symptoms in this disease are not significant, the slaughterhouse inspection becomes doubly important. The prevalence of Dicrocoelium infection in sheep and goats in the northeastern regions of the country was 4.53 percent and 1.4 percent. Also, the prevalence of Dicrocoelium in sheep and goats of Mazandaran province was reported as 2.4 percent and 1.85 percent, respectively (Arbabi *et al.,* 2011).

In the present study, the share of Dicrocoeliasis among liver infections in the liver of slaughtered sheep of Birjand industrial slaughterhouse was 26.96%, which caused the removal of about 213.938 kilograms of liver and caused direct economic damage in the amount of about 320907170 Rials became.

In the case of most Sarcocyst species due to their small size, microscopic examination is required for diagnosis and only a small number of Sarcocyst species are detected in the slaughterhouse, which is the reason for the low prevalence of Sarcocyst in the present study, as in many studies Among them, Mirzaei and Rezaei in Iran and Zuo in China have reported 100% infection rate of sheep with Sarcocyst (their laboratory diagnosis method was digestion and microscopic examination) (Mirzaei & Rezaei, 2016; Zuo, 1992). The interesting thing is that the few Sarcocysts that can be seen with the eyes have caused a loss of about 40 million Rials due to the seizure of livers.

In the case of Cysticercus tenuicollis, according to the amount of cyst in the liver, removal can be partial or complete. According to Khanjari et al., study in Amol slaughterhouse (Mazandaran province), 4.21 slaughtered sheep and goats were infected with Taenia hydatigena larvae (Khanjari *et al.,* 2015), which is a much higher prevalence compared to the results of the current research. In the current research, the amount of liver infection of sheep with Cysticercus tenuicollis was 0.35 percent, which caused the removal of 54 kg of liver and as a result, a loss of about 80 million Rials.

Conclusion

According to the investigations, it seems that the economic losses caused by parasitic infections in the animal husbandry industry of our country are unimaginable and very high. Because as it was shown in the present research, in Birjand city, which due to climatic and geographical conditions, there is not very suitable animal husbandry and the population of livestock there is not significant. Parasitism has caused the important point is that many other organs of the slaughtered animals were infected with parasites, which were not included in the present research. In addition, the indirect damages caused by parasites (such as reduced production, weight loss, reduced fertility, etc.) are far more than the direct damages caused by them. Therefore, it can be concluded that, firstly, the control and prevention of parasitic infections and secondly, the treatment of animals infected with parasites is not only necessary, but must be followed and implemented with speed and seriousness.

Conflict of interest

The authors have no conflicts of interest to declare.

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Kazerun Branch
Fars, Iran

مطالعه کشتارگاهی میزان شیوع و خسارات اقتصادی مستقیم انگل های کبدی در گوسفندان شهرستان بیرجند

علی کریمی[1*]، رضا فرهمند راد[2]

[1]گروه انگل شناسی، واحد کازرون، دانشگاه آزاد اسلامی، کازرون، ایران
[2]دانش آموخته دکتری عمومی دامپزشکی، واحد کازرون، دانشگاه آزاد اسلامی، کازرون، ایران

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چکیده

زمینه و هدف: انگل های کبدی یکی از مهمترین گروه های انگلی می باشند که علاوه بر ایجاد بیماری در حیوانات میزبان دارای اهمیت زئونوتیک نیز می باشند. این مطالعه با هدف بررسی کبدهای گوسفندان کشتار شده در کشتارگاه صنعتی شهرستان بیرجند و شناسایی آلودگی های انگلی در آن ها، یافتن علت آلودگی و تخمین خسارت های مستقیم اقتصادی ناشی از آن ها انجام گردید.

مواد و روش‌ها: مطالعه حاضر از نوع توصیفی تحلیلی بود و به صورت مقطعی در چهار فصل بهار، تابستان، پاییز و زمستان سال ۱۴۰۰ انجام گرفت. در مدت زمان انجام تحقیق با مراجعه به کشتارگاه، کبدهای حذفی جمع آوری شده و در شرایط سرد و بر روی کیسه های یخ به آزمایشگاه انگل شناسی منتقل شدند. در آزمایشگاه با بررسی ظاهری و همچنین برش های عمقی در بافت کبد، کیست های احتمالی موجود در کبد تحت بررسی های تشخیصی قرار گرفت.

یافته‌ها: در مدت زمان ۱۲ ماهه انجام تحقیق، ۱۵۳۱۹ راس گوسفند کشتار شد که از این تعداد ۷۹۰ گوسفند دارای آلودگی انگلی در کبدهایشان بودند. کبدهای آلوده به صورت کلی یا جزئی حذف شدند. مجموع حذفیات کبد ناشی از انگل ها ۷۹۳ کیلوگرم برآورد گردید که این مقدار بر اساس قیمت روز (هر کیلو کبد: یک میلیون و پانصد هزار ریال) یک میلیارد و صد و هشتاد و نه میلیون و پانصد هزار ریال (۱۱۸۹۵۰۰۰۰۰ ریال) محاسبه گردید. انگل های مشاهده شده در کبدهای آلوده عبارت بودند از: کیست هیداتید، فاسیولا، دیکروسلیوم، سیستی سرکوس تنیاکولیس و سارکوسیست.

نتیجه‌گیری: با توجه به وسعت و حجم آلودگی و با عنایت به خسارت ریالی مستقیم ناشی از آلودگی های انگلی در شهرستان بیرجند می توان حدس زد که انگل ها سالانه مبالغ بسیار هنگفت و چشمگیری خسارت به صنعت دامپروری کشور وارد می کنند.

واژه‌های کلیدی: *انگل های کبدی، گوسفند، خسارت اقتصادی، بیرجند*

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* *نویسنده مسئول: گروه انگل شناسی، واحد کازرون، دانشگاه آزاد اسلامی، کازرون، ایران.*
Orcid: https://orcid.org/0000-0002-8773-8772 ،Email: alikarimi224@yahoo.com

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