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ORIGINAL ARTICLE

Prevalence of liver fluke infections in slaughtered animals in Lorestan, Iran

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Abstract *Fasciola* spp. and *Dicrocoelium dendriticum* as liver flukes, contaminate ruminants and other mammalian extensively and cause major diseases of livestock that create considerable economic losses. This retrospective study has been done to evaluate contamination rate of slaughtered animals with fasciolosis and dicrocoeliosis at Lorestan abattoirs. In this survey, prevalence rate of fasciolosis and dicrocoeliosis in slaughtered animals in a 3-year period (2010–2013) has been analyzed. A total of 356,605 livestock including 265,692 sheep and 90,913 goats were slaughtered in the 3-year period and overall 39,613 (11.1 %) livers were condemned. Fascioliasis and dicrocoeliosis were responsible for 6.3 and 4.8 % of total liver condemnations in this period, respectively. *Fasciola* spp. and *D. dendriticum* infection in sheep (7.1 and 5.6 %, respectively) were considerably higher than goats (3.9 and 2.6 %, respectively). The annual prevalence rates showed a significant decline in the fasciolosis and dicrocoeliosis infection in goats ($p < 0.001$). Data showed significant seasonal pattern for distomatosis in sheep and goats ($p < 0.001$). Liver condemnations due to fasciolosis were prevalent in sheep and goats slaughtered during spring and autumn, respectively, whereas dicrocoeliosis were common in spring season for both sheep and goats. This survey provides baseline data for the future monitoring of these potentially important parasitic infections in the region.

Keywords Prevalence · Fasciolosis · Dicrocoeliosis · Sheep · Goats · Lorestan

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Introduction

Information resulting from meat inspection records has been used as useful sources of data for evaluation of the epidemiological aspects of certain diseases in several countries (Ahmadi 2005; Azami et al. 2013; Ansari-Lari and Moazzeni 2006; Ezatpour et al. 2013b). Among diseases which are not often apparent to the farmers, fasciolosis and dicrocoeliosis are of considerable economic and public health importance. Distomatosis caused by *Dicrocoelium dendriticum* and *Fasciola* spp. (*Fasciola hepatica*; *Fasciola gigantica*) are common in grazing ruminants in many countries in the world including Iran (Ansari-Lari and Moazzeni 2006; Mas-Coma et al. 2005; Moghaddam et al. 2004).

The trematodes *F. hepatica* and *D. dendriticum* are recognized as the most important helminthic parasites in ruminants and causing economic losses to ranchers due to reductions in milk and meat production, condemnation of parasitized livers, abortion, increased mortality and the expense of control measures (Carnevale et al. 2013). In Iran, the main enzootic area of sheep liver trematodes lies

in the north of Iran, but *Fasciola* spp. and *D. dendriticum* also occur in the southwest region of Iran. *Fasciola* spp.and *D. dendriticum* are found in many parts of the world (Mas-Coma 2004). In chronic infections, these parasites cause biliary cirrhosis in the livers of cattle and sheep, leading to economic losses (Otranto and Traversa 2002). In the last decade various studies about the prevalence of fasciolosis and dicrocoeliosis in cattle and sheep have been conducted in different parts of Iran (Ghazani et al. 2008).

The incidence of human fasciolosis has been increasing in 51 countries of the five continents (Esteban et al. 1998; Mas-Coma et al. 1999; Mas-Coma et al. 2005). Recent papers estimate human infection up to 2.4 million, up to 17 million people, or even higher depending on the unknown situations in many countries, mainly of Asia and Africa (Mas-Coma 2004, 2005).Whereas, dicrocoeliosis occasionally affects humans (Otranto and Traversa 2002). In Iran human fasciolosis was sporadic until 1987, when an outbreak occurred in Iran (Gilan Province) and affected more than 10,000 people (Ashrafi et al. 2004). The second outbreak occurred 10 years later and several thousand people were infected (Ashrafi et al. 2004). Reports of several hundred cases of human disease during interepidemic periods and recent years are present. Recently, a minor emergence of fascioliasis, with 17 non-fatal cases, reported in the Kermanshah, western Province of Iran (Hatami et al. 2000). Human dicrocoeliosis has already been established in Isfahan Province, Iran (Farid 1971), though that is very rare. In the absence of statistically and epidemiologic data, evaluating liver fluke prevalence in livestock based on liver condemnation statistics might be useful. Information about infections of cattle, sheep and goats with liver fluke in south-western Asia were reported from some countries such as Iraq (Al-Khafaji et al. 2003), Pakistan (Sharma and Raina 1989), Saudi Arabia (Over et al. 1992) and Turkey (Gül and Aydin 2008). An old report has only been published on prevalence of Liver fasciolosis in sheep, cattle, goats and buffaloes from Ahwaz, Iran (Ahmadi and Meshkehkar 2010), although several reports exist on those in other regions of Iran (Daryani et al. 2006; Moghaddam et al. 2004). Since in southwestern Iran, there are high farms and green pastures (Ezatpour et al. 2013a) and there was not any data about *Fasciola* and *Dicrocoelium*, this survey was designed to study the presence and distribution of liver flukes in pastured ruminants in Khorramabad, Lorestan Province, Iran.

Materials and methods

This retrospecific study was conducted from 3 April 2010 to 3 April 2013, spanning all four seasons of the year in Lorestan. Lorestan Province is located in the west of Iran, within 46°51′ and 50°3′E longitude and 32°37′ and 34°22′N latitude. This Province is a semiarid region in west of Iran and the total area of it is 28,300 km^2 (Asakereh et al. 2011). All daily condemnation records for sheep and goats in the abattoirs of different localities in Lorestan Province were used. The livers of 356,605 animals including 265,692 sheep and 90,913 goats were inspected according to the method described to recognize fascioliasis and dicrocoeliosis (Gracey et al. 1999). The parasites were identified by morphological characteristics of them (Reinecke 1983). The recorded data, acquired with visualization, palpation and incision of livers, was used to extract the prevalence rate of these parasites.

Chi square test was used for comparison of the prevalence rates of fasciolosis and dicrocoeliasis between different animal species and for comparison of the prevalence rates between seasons for the same animal species. Differences were considered significant when $p < 0.05$, using computer software SPSS version 16 for windows.

Results

In the present investigation, the carcasses of 356,605 including 265,692 sheep and 90,913 goats were examined in 3-year period. The overall prevalence of distomatosis infection was 11.1 %. The infection rates due to *Fasciola* spp. and *Dicrocoelium dendriticum* were 6.3 and 4.8 %, respectively. There was highly significant difference in *Fasciola* spp. and *Dicrocoelium dendriticum* infection between sheep and goats ($p < 0.001$). *Fasciola* spp. and *D. dendriticum* infection in sheep (7.1 and 5.6 %, respectively) were considerably higher than goats (3.9 and 2.6 %, respectively).

Data showed significant seasonal pattern for distomatosis infection in animals study (Tables 1 and 2). The highest prevalence of fasciolosis observed in spring for sheep ($p < 0.001$, $X^2 = 2224.5$) and autumn for goats ($p < 0.001$, $X^2 = 1370.4$). Also, the highest prevalence of dicrocoeliosis observed in spring for both sheep ($p < 0.001$, $X^2 = 414.2$) and goats ($p < 0.001$, $X^2 = 104.8$). The annual prevalence rates for these parasitic infections in 3-year period showed a significant decline in the fasciolosis and dicrocoeliosis infection in goats.

Discussion

Liver fluke infections cause considerable economic loss in livestock due to condemnation of organs and reduction of milk and meat production. Although abattoir surveys have limitations, they are an economical way of gathering information on livestock disease. Inspection records of the

Table 1 Seasonal prevalence rate of *Fasciola* spp. condemned livers in slaughtered animals in Lorestan, Iran

Year	Animals	Spring		Summer		Autumn		Winter		Total	
		N	Inf (%)	*N*	Inf (%)	*N*	Inf (%)	*N*	Inf (%)	*N*	Inf (%)
2010	Sheep	54,266	1,451 (2.7)	73,127	1,380 (1.9)	60,443	2,301 (3.8)	38,511	2,326 (6)	226,377	7,458 (3.3)
	Goats	5,039	376 (7.5)	6,229	462 (7.4)	6,390	515 (8)	5,211	207 (4)	22,869	1,560 (6.8)
2011	Sheep	35,071	2,238 (6.4)	26,359	1,848 (7)	18,224	1,043 (5.7)	14,711	1,158 (7.9)	94,365	6,287 (6.7)
	Goats	5,001	191 (3.8)	7,925	238 (3)	8,653	625 (7.2)	5,781	392 (6.8)	27,360	1,446 (5.3)
2012	Sheep	24,820	1,073 (4.3)	29,883	1,177 (3.9)	49,554	1,520 (3)	40,693	1,416 (3.5)	144,950	5,186 (3.6)
	Goats	4,935	61 (1.2)	11,125	202 (1.8)	15,205	167 (1.1)	9,419	115 (1.2)	40,684	545 (1.3)
Total	Sheep	59,891	4,762 (8)	129,369	4,405 (3.4)	128,221	4,864 (3.8)	93,915	4,900 (5.2)	265,692	18,931 (7.1)
	Goats	14,975	628 (4.2)	25,279	902 (3.6)	30,258	1,307 (4.3)	20,411	714 (3.5)	90,913	3,551 (3.9)

N number of animals examined, *Inf* infected animals

Table 2 Seasonal prevalence rate of *Dicrocoelium dendriticum* condemned livers in slaughtered animals in Lorestan, Iran

Year	Animals	Spring		Summer		Autumn		Winter		Total	
		N	Inf (%)	*N*	Inf (%)	*N*	Inf (%)	*N*	Inf (%)	*N*	Inf (%)
2010	Sheep	54,266	751 (1.4)	73,127	890 (1.2)	60,473	1,118 (1.8)	38,511	994 (2.6)	226,377	3,753 (1.6)
	Goats	5,039	320 (6.3)	6,229	321 (5.1)	6,390	374 (5.8)	5,211	90 (1.7)	22,869	1,105 (4.8)
2011	Sheep	35,071	1,362 (3.9)	26,359	2,731 (10.4)	18,224	1,271 (7)	14,711	910 (6.2)	94,365	4,912 (5.2)
	Goats	5,001	129 (2.6)	7,925	171 (2.1)	8,653	109 (1.2)	5,781	135 (2.3)	27,360	544 (2)
2012	Sheep	24,820	908 (3.6)	29,883	1,054 (3.8)	49,554	1,899 (3.8)	40,693	2,272 (5.6)	144,950	6,133 (4.2)
	Goats	4,935	91 (1.8)	11,125	169 (1.5)	15,205	266 (1.7)	9,419	158 (1.7)	40,684	684 (1.7)
Total	Sheep	59,891	3,021 (5)	129,369	4,675 (3.6)	128,221	4,288 (3.3)	93,915	265,692	265,692	18,931 (7.1)
	Goats	14,975	540 (3.6)	25,279	661 (2.6)	30,248	749 (2.5)	20,411	383 (1.9)	90,913	3,551 (3.9)

N number of animals examined, *Inf* infected animals

slaughtered animals have been used as useful source for evaluation of the epidemiological aspect of certain disease in several countries (Azami et al. 2013). It is suggested that an efficient meat inspection service should function as an important monitor of animal disease, being particularly valuable in the field of chronic and ill-defined conditions which are not apparent to either the stockowner or his veterinary surgeon but must be of considerable economic and animal health significance (Blamire et al. 1980). Also, a feedback from the slaughterhouse to the individual farm is of great value in the field of preventive medicine.

Fasciola spp. and *D. dendriticum* are common parasites of ruminants in different parts of Iran (Ansari-Lari and Moazzeni 2006; Daryani et al. 2006; Moghaddam et al. 2004; Sahba et al. 1972). At the end of the 1980s and during the 1990s several large epidemics, including thousands of human fasciolosis, were reported (Ashrafi et al. 2004; Moghaddam et al. 2004) in Iran; whilst human dicrocoeliosis has seldom been reported. In 2000, there was a minor emergence of fasciolosis, in the western Province of Kermanshah (Hatami et al. 2000).

In the present survey, fascioliasis and dicrocoeliosis were responsible for 6.3 and 4.8 % of total liver infected, respectively. On the other hand the prevalence of *Fasciola* spp. in sheep 7.1 % and goats was 3.9 %, respectively. As such prevalence of *D. dendriticum* in sheep and goats was 5.6 and 2.6 %, respectively.

In a slaughterhouse survey in ruminants of Tehran, 31.2 % of sheep and 64.3 % of goats were infected with *F. hepatica* (Eslami et al. 1976). The overall prevalence of fascioliasis was lower than previous report in the region that showed 22.8 % of sheep and 11.4 % of goats were infected (Ahmadi and Meshkehkar 2010). In a study in Ardabil Province (Daryani et al. 2006), reported that prevalence of *Fasciola* spp. in sheep and goats was 5.3 and 4.9 %; as such prevalence of *D. dendriticum* in those animals was 6.8, and 12.4 %, respectively. In a slaughterhouse survey of ruminants of Mazandaran Province 5.7 % of sheep and 1.6 % of goats were infected with *Fasciola* spp. (Moghaddam et al. 2004). Other studies were carried out in Iran, reported variable prevalence rates of *Fasciola* spp. and *D. dendriticum* in different regions of the country. A study reported that 82 and 27.1 % of cattle and sheep livers were infected in Khouzestan Province by *F. hepatica*, respectively (Sahba et al. 1972). In a study conducted in the northwest region of Iran, 8.57 and 20 % of sheep livers

were infected by *F. hepatica* and *D. dendriticum*, respectively (Ghazani et al. 2008). In the other study the prevalence rate of *F. hepatica* in ruminants of Guilan and Mazandaran Provinces was 21.5 and 12 % and this rate for Tehran Province was 31.2 % of sheep and 64.3 % of goats (Eslami 1979). The prevalence rate of fascioliasis and dicrocoeliosis in sheep in Meisam abattoir, Tehran, were 2.01 and 5.83 % respectively (Khanjari et al. 2012). In a study performed in slaughterhouse of Khorramabad in Lorestan Province, 9.5 % of sheep and goats were infected with liver trematodes and 1.6 % of liver were condemned (Soukhtezari et al. 2000). Almost 4.1 % of sheep slaughtered in Shahr-e Kord were infected with *F. hepatica* (Manouchehehri Naini and Bagheri 2000). This was in agreement with the data obtained in our study. In Shiraz city study the prevalence rate of fasciolosis in cattle and sheep were 2.91 and 2.10 %, respectively, whereas the prevalence rate of dicrocoeliosis were 1.00 and 0.80 % in cattle and sheep, respectively (Ansari-Lari and Moazzeni 2006).

Studies carried out in the neighboring countries of Iran have reported different prevalence in different animals. In Pakistan (Kashmir), infection rate of *F. hepatica* in sheep and goats was 51.3, and 14.8 %, respectively (Sharma and Raina 1989). In Turkey, 3.99 and 23.55 % of sheep and 0.48 and 2.65 % of cattle were infected with *F. hepatica* and *D. dendriticum*, respectively (Gargili et al. 1999). In Iraq, an abattoir survey in Basrah revealed that the prevalence for hepatic fasciolosis among sheep and goats was 0.72, and 3.30 %, respectively (Wajdi and Nassir 1983). The corresponding figures from Saudi Arabia fascioliasis were 0.04 and 0.00 % in sheep and goats, respectively (Over et al. 1992). On the whole, infection with *Fasciola* spp. and *D. dendriticum* in ruminants of Khoramabad was less than different researchers at more different area in Iran. In comparison to Iran, Pakistan (Kashmir region), a neighboring country, has shown a higher rate in all species (Sharma and Raina 1989), but infection with *Fasciola* in livestock of Lorestan Province was more than that in Saudi Arabia and Turkey (Gargili et al. 1999; Over et al. 1992).

A significant relationship between *Fasciola* spp. infection and season was also seen in sheep and goats during our study. In all animal species (sheep and goats respectively) the highest infection rate due to *Fasciola* spp. was seen in the spring and autumn, respectively. The higher prevalence of infection during these seasons can be correlated with the meteorological data, which indicated high rainfall during autumn and spring and also with the prevalence of infection in snails, which was high during rainfall periods compared to other months of the year. Researchers (Khallaayoune and El Hari 1991) showed that the main periods for transmission of fasciolosis were spring and fall; however, potential infections during other periods of the year were possible.

The present study revealed the highest infection rate of dicrocoeliosis in sheep (5.6 %). Our results showed statistical difference between seasonal pattern and dicrocoeliosis infection in goats and sheep. The higher prevalence of infection was seen in spring for sheep and goats that this is close to the results reported from Kashan (Ali et al. 2011), Ardebil (Daryani et al. 2006) and Mazandaran (Moghaddam et al. 2004). In small ruminants, sheep seem to be more susceptible to *D. dendriticum* than goats (Jithendran and Bhat 1996). Animal age and relative susceptibility to the parasite have not yet been fully elucidated (Manga-Gonzalez et al. 1990). Results indicate that the age of infected animals might influence the egg output rate, although further investigations are needed on this issue (Manga-Gonzalez et al. 1990). Finally, stress-inducing factors such as animal transportation and cold temperature proved to enhance *Dicrocoelium* egg production, probably inducing immune depression in animals (Sotiraki et al. 1999). Goats fasciolosis is considered less frequent than sheep and infection; however, fasciolosis occurs as a major constraint for goat production in many areas of the world. The response against this parasite is stated to be host specific and differs in different host species.

The main reason for low prevalence of dicrocoeliosis is drought condition and the effect that is would have on the snail intermediate hosts. So, climatic condition could be responsible for this improvement and low prevalent. The other reason is the movement of the animals from lowland to mountain pastures where they become infected by the ants and then bring the infection back to the valley during the cold seasons (Eckert and Hertzberg 1994; *Jithendran* and Bhat 1996). Moreover, the migratory period seems to predispose animals to infection, not only because of the presence of intermediate hosts, but also for the high stress induced by the transhumance on pasture-grazing nomadic sheep and goats (Oryan et al. 2011; Otranto and Traversa 2002).

Conclusion

Liver infection due to distomatosis were more prevalent in small ruminants during spring season. Different weather in different seasons in Lorestan area may be differences in parasitic infection. In general, data from the current study showed an increase in the prevalence of fasciolosis. Therefore, more action is suggested to control the disease in this region of Iran. To reach this goal, a stronger monitor of ruminants and treatment them are highly recommended.

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Conflict of interest None of the authors had conflict of interest.

References

Ahmadi N (2005) Hydatidosis in camels (*Camelus dromedarius*) and their potential role in the epidemiology of *Echinococcus granulosus* in Iran. J helminth 79:119–126

Ahmadi NA, Meshkehkar M (2010) Prevalence and long term trend of liver fluke infections in sheep, goats and cattle slaughtered in Khuzestan, southwestern Iran. J Paramed Sci 1:26–31

Ali TS, Zarichehr V, Reza TM, Amroallah B, Hossin T, Amir M, Akbar T et al (2011) Prevalence of liver flukes infections in slaughtered animals in Kashan, Isfahan Province, central Iran. IIOAB J 2:14–18

Al-Khafaji N, Ridha A, Jarjees M (2003) Common parasitic infections of livers of ruminants slaughtered in Mosul abattoir, Iraq. Iraqi J Vet Sci 16:81–87

Ansari-Lari M, Moazzeni M (2006) A retrospective survey of liver fluke disease in livestock based on abattoir data in Shiraz, south of Iran. Prev Vet Med 73:93–96

Asakereh A, Safaienejad M, Sami M (2011) Energy and economic analysis of dry farming chickpea in Iran a case study: lorestan Province. J Agri Tech 7:547–555

Ashrafi K, Massoud J, Holakouei K, Mahmoodi M, Joafshani M, Valero M, Fuentes M et al (2004) Evidence suggesting that *Fasciola gigantica* might be the most prevalent causal agent of fascioliasis in northern Iran. Iran J Pub Health 33:31–37

Azami M, Anvarinejad M, Ezatpour B, Alirezaei M (2013) Prevalence of hydatidosis in slaughtered animals in Iran. Turk Parazit Derg 37:102–106

Blamire R, Goodhand R, Taylor K (1980) A review of some animal diseases encountered at meat inspections in England and Wales, 1969 to 1978. Vet Rec 106:195–199

Carnevale S, Cabrera M, Cucher M, Risio C, Malandrini J, Kamenetzky L et al (2013) Direct, immunological and molecular techniques for a fasciolosis survey in a rural area of San Luis, Argentina. J Parasit Dis 37:251–259

Daryani A, Alaei R, Arab R, Sharif M, Dehghan M, Ziaei H (2006) Prevalence of liver fluke infections in slaughtered animals in Ardabil Province, northwestern Iran. J Anim Vet Adv 5:408–411

Eckert J, Hertzberg H (1994) Parasite control in transhumant situations. Vet Parasit 54:103–125

Eslami A (1979) Veterinary helminthology trematoda. Tehran University Publication 1, 29–30

Eslami A, Nayeri-Rad M, Salehi M, Faizy A (1976) Trematode infestations of liver of ruminants in Tehran abattoir. J Vet Fac Univ Tehran 32:21–26

Esteban J, Bargues M, Mas-Coma S (1998) Geographical distribution, diagnosis and treatment of human fascioliasis: a review. Res Rev Parasitol 58:13–42

Ezatpour B, Chegeni AS, Abdollahpour F, Aazami M, Alirezaei M (2013a) Prevalence of parasitic contamination of raw vegetables in Khorramabad, Iran. Food Cont 34:92–95

Ezatpour B, Farhadi SJ, Azami M, Alirezaei M, Ebrahimzadeh F (2013b) Importance of cystic echinococcosis in slaughtered herbivores from Iran. J Parasit Dis. doi:10.1007/s12639-013-0328-z

Farid H (1971) Human infection with *Fasciola hepatica* and *Dicrocoelium dentriticum* in Isfahan area, central Iran. J Parasitol 57:160

Gargili A, Tuezer E, Guelanber A, Toparlak M, Efil I, Keles V, Ulutas M (1999) Prevalence of liver fluke infections in slaughtered animals in Trakya (Thrace), Turkey. Turk J Vet Anim Sci 23:115–116

Ghazani MHM, Valilou MR, Ahmadzadeh AR, Karami AR, Zirak K (2008) The prevalence of sheep liver trematodes in the northwest region of Iran. Turk J Vet Anim Sci 32:305–307

Gracey J, Collins D, Huey R (1999) Fat rancidity. Meat hygiene, 10th edn. Harcourt Brace and Company Limited, London

Gül A, Aydin A (2008) Prevalence of liver flukes in hair goats slaughtered in Hakkari (Yüksekova Province). Turk Parazit Derg 32:334

Hatami H, Asmar M, Massoud J, Aryanifar S, Mansori F, Fatemi S, Shahrezaei A et al (2000) Report of the first outbreak of human fasciolosis in Kermanshah Province. Moddares J 3:79–87

Jithendran K, Bhat T (1996) Prevalence of dicrocoeliosis in sheep and goats in Himachal Pradesh, India. Vet Parasitol 61:265–271

Khallaayoune K, El Hari M (1991) Seasonal variations of *Fasciola hepatica* infection in goats in the area of Haouz (Morocco). Annal Vet Res 22:219

Khanjari A, Partovi R, Abbaszadeh S, Nemati G, Bahonar A, Misaghi A, Akhondzadeh-Basti A et al (2012) A retrospective survey of Fasciolosis and Dicrocoeliosis in slaughtered animals in Meisam Abattoir, Tehran, Iran (2005–2008). Vet Res Forum 1:174–178

Manga-Gonzalez MY, Gonzalez-Lanza C, Del-Pozo-Carnero P (1990) Dynamics of the elimination of *Dicrocoelium dendriticum* (Trematoda, Digenea) eggs in the faeces of lambs and ewes in the Porma basin (Leon, NW Spain). Annal Parasitol Hum Comp 66:57–61

Manouchehehri Naini K, Bagheri B (2000) Prevalence of *Fasciola hepatica* in sheep slaughtered in Shahr-Kord In: 3rd National Congress of Medical Parasitology, Sari, Iran, p 1117

Mas-Coma S (2004) Human fascioliasis: epidemiological patterns in human endemic areas of South America, Africa and Asia. Southeast Asian J Trop Med Public Health 35:1–11

Mas-Coma M, Esteban J, Bargues M (1999) Epidemiology of human fascioliasis: a review and proposed new classification. Bull World Health Organ 77:340–346

Mas-Coma S, Bargues M, Valero M (2005) Fascioliasis and other plant-borne trematode zoonoses. Inter J Parasitol 35:1255–1278

Moghaddam A, Massoud J, Mahmoodi M, Mahvi A, Periago M, Artigas P, Fuentes M et al (2004) Human and animal fascioliasis in Mazandaran Province, northern Iran. Parasitol Res 94:61–69

Oryan A, Mansourian M, Moazeni M, Nikahval B, Barband S (2011) Liver distomatosis in cattle, sheep and goats of Northeastern Iran. Global Vet 6:241–246

Otranto D, Traversa D (2002) A review of dicrocoeliosis of ruminants including recent advances in the diagnosis and treatment. Vet Parasitol 107:317–335

Over HJ, Jansen J, Van Olm P (1992) Distribution and impact of helminth diseases of livestock in developing countries. FAO

Reinecke R (1983) Veterinary helminthology. Butterworth & Co. (SA) (Pty.) Ltd

Sahba G, Arfaa F, Farahmandian I, Jalali H (1972) Animal fascioliasis in Khuzestan, southwestern Iran. J Parasitol 58(4):712–716

Sharma R, Raina O (1989) Studies on the prevalence and laboratory transmission of fascioliasis in animals in the Kashmir valley. Brit Vet J 145:57–61

Sotiraki S, Leontides L, Himonas C (1999) The effect of transportation and confinement stress on egg production by *Dicrocoelium dendriticum* in sheep. J Helminth 73:337–340

Soukhtezari A, Atesh Parvar D, Goudarzi G (2000) Prevalence of Fasciola and dicrocoelium in sheep and goats slaughtered in Khorram Abad, In: 3rd National Congress of Medical Parasitology, Sari, Iran p 253

Wajdi N, Nassir J (1983) Studies on the parasitic helminths of slaughtered animals in Iraq. I. Parasitic helminths of the liver of herbivores. Annal Trop Med Parasitol 77:583