A RETROSPECTIVE STUDY OF ABATTOIR CONDEMNATION DUE TO PARASITIC INFECTIONS: ECONOMIC IMPORTANCE IN AHWAZ, SOUTHWESTERN IRAN

Hassan Borji, Mohammad Azizzadeh*, and Mehrab Kamelli
Department of Pathobiology, School of Veterinary Medicine, Ferdowsi University of Mashhad, P.O. Box 9177948974, Mashhad, Iran. e-mail: hborji@um.ac.ir
Parasitic diseases are considered as a major obstacle in the health and food safety with animal origin and cause economic loss in countries where livestock industry is an important segment of the agricultural products. Considering the economic significance resulting from parasitic diseases in Iran, financial losses were estimated at various levels in different locations. Hence, it would be essential to have information on the status of parasitic diseases with regard to its magnitude of occurrence and negative economic impact from different parts of the country to establish an appropriate strategy for prevention and control. Yet, information regarding financial loss due to parasite-related condemnation of offal and meat is very limited in Khuzestan Province, which is an important livestock production area located in southwestern Iran. Therefore, the objectives of the current study were to determine the prevalence of parasitic infections responsible for the condemnation of carcasses and viscera during meat inspection, and their economic impact in this region.

MATERIALS AND METHODS

This study was based on a retrospective survey covering a 5-yr period (20 March 2006–19 March 2011) in an abattoir in Ahwaz, capital of Khuzestan Province. The study area has great potential for agricultural expansion because of large water reservoirs associated with the Karoun and Karkheh Rivers. In 2011, livestock populations included approximately 2,661,000 sheep, 1,369,000 goats, 399,000 cattle, and 102,000 buffalos (www.ivo.org.ir). Ahwaz has a semiarid climate with long, extremely hot summers and mild, short winters. The average annual rainfall in this area is about 230 mm and air temperature ranges between 4 and 50 °C in cold and warm seasons, respectively.

Meat inspection records of an abattoir were provided by an experienced team of veterinarians. The number and type of organs or condemned carcasses, and the reason for each condemnation were recorded daily on standardized data sheets. For the present study, the condemnation data were gathered on a yearly (March–March) basis. In April 2011, with the use of information from meat markets in the study area, the average monetary values of sheep, goat, cattle or buffalo carcasses were $725, $725, $1,100 and $1,100 (U.S.), respectively. The prices of sheep, goat, cattle, and buffalo were $18, $18, $13.6, and $13.6 (U.S.), respectively. The lungs of sheep, goats, cattle, and buffalos were priced at $2.7, $2.7, $0.9, and $0.9 (U.S.), respectively. These commercial values were then used to estimate the economic loss represented by the parasite-related condemnations over a 5-yr study period.

For data analysis, version 16 of the SPSS software package (SPSS Inc., Chicago, Illinois) was used. Proportion of organ and carcass condemnations between, and within, species was compared with the use of a chi-square test. Annual trends in risks of liver, lung, and carcass condemnations across the 5-yr period were calculated (Armitage et al., 2002) for each host and parasite separately. P ≤ 0.05 were considered as statistically significant.

RESULTS

Between 20 March 2006 and 19 March 2011, 125,593 cattle, 1,191,871 sheep, 240,221 goats, and 25,010 buffalos were slaughtered. The livers of 58,753 (3.7%; 95% confidence interval [CI]: 3.7–3.8%), the lungs of 34,522 (2.2%; 95% CI: 2.1–2.3%), and the carcasses of 78 (0.0049%; 95% CI: 0.00485–0.0049%) of these animals were condemned. Proportions of liver, lung, and carcass condemnations during the 5-yr study period in buffalos were significantly greater than the other species (P < 0.001). Frequency of liver condemnation during the 5-yr period for cattle was greater than sheep and goats (P < 0.001), but condemnation of lungs in goat was significantly greater than sheep and cattle (P < 0.001). The parasitic lesions observed in the condemned livers were attributed to Echinococcus granulosus, Fasciola hepatica, or Dicrocoelium dendriticum, or some combination of these species. All the parasitic lesions observed in the condemned lungs from cattle, sheep, goat, and buffalos were ascribed to E. granulosus. Sarcocystis spp. cysts were found in ovine and buffalo muscles, whereas Taenia sp. cysticerci were detected in bovine muscle. Muscles of goats were devoid of any parasitic lesions. Parasites were responsible for 54.1% of the condemned organs or carcasses, with a retail value (based on market prices in 2011) of $1,148,181 (U.S.) ($137,880 for cattle, $602,699 for sheep, $280,955 for goats, and $126,647 for buffalos). The parasites contributing most to the condemnation of otherwise marketable organs and flesh were E. granulosus (29.2%) and F. hepatica (18.6%). These parasites clearly remain the most common, causing considerable economic loss in Khuzestan Province and, presumably, other areas of Iran.

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* To whom correspondence should be addressed. Department of Clinical Science, School of Veterinary Medicine, Ferdowsi University of Mashhad, Mashhad, Iran.
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**Abstract.** A 5-yr retrospective study in livestock slaughtered in abattoirs was carried out in Khuzestan Province (southwestern Iran) to determine the prevalence of parasitic infections responsible for condemnation of slaughtered animals’ carcasses and viscera. The economic importance of such infections in terms of lost meat and offal were also estimated. Between 20 March 2006 and 19 March 2011, 125,593 cattle, 1,191,871 sheep, 240,221 goats, and 25,010 buffalos were slaughtered in the study area; the livers of 58,753 (3.7%; 95% confidence interval [CI]: 3.7–3.8%), the lungs of 34,522 (2.2%; 95% CI: 2.1–2.3%), and the carcasses of 78 (0.0049%; 95% CI: 0.00485–0.0049%) of these animals were condemned. Proportions of liver, lung, and carcass condemnations during the 5-yr study period in buffalos were significantly greater than the other species (P < 0.001). Frequency of liver condemnation during the 5-yr period for cattle was greater than sheep and goats (P < 0.001), but condemnation of lungs in goat was significantly greater than sheep and cattle (P < 0.001). The parasitic lesions observed in the condemned livers were attributed to Echinococcus granulosus, Fasciola hepatica, or Dicrocoelium dendriticum, or some combination of these species. All the parasitic lesions observed in the condemned lungs from cattle, sheep, goat, and buffalos were ascribed to E. granulosus. Sarcocystis spp. cysts were found in ovine and buffalo muscles, whereas Taenia sp. cysticerci were detected in bovine muscle. Muscles of goats were devoid of any parasitic lesions. Parasites were responsible for 54.1% of the condemned organs or carcasses, with a retail value (based on market prices in 2011) of $1,148,181 (U.S.) ($137,880 for cattle, $602,699 for sheep, $280,955 for goats, and $126,647 for buffalos). The parasites contributing most to the condemnation of otherwise marketable organs and flesh were E. granulosus (29.2%) and F. hepatica (18.6%). These parasites clearly remain the most common, causing considerable economic loss in Khuzestan Province and, presumably, other areas of Iran.
**Fasciola hepatica** (adults), *Echinococcus granulosus* (hydatid cysts), and *Dicrocoelium dendriticum* (adults). Of the cattle livers inspected over the entire study period, 5.3% were condemned because they harbored *F. hepatica*. Percentages for sheep, goats, and buffalos were 0.9, 2.3, and 10.4%, respectively. The proportion of liver condemnation due to fascioliasis in buffalos was significantly greater than cattle, sheep, and goats. Also, condemnation for cattle was significantly greater than for sheep and goats (*P* < 0.001). The annual prevalence for these parasitic infections in the study period is shown in Figure 2A. The overall trends were significant for cattle, sheep, and buffalos (*P* < 0.001). The proportions of condemned liver due to hydatid disease in cattle, sheep, goats, and buffalos during the study period were 2.4, 1.4, 3.2, and 4.3%, respectively. The proportion of liver condemnation because of hydatid cysts in buffalos was significantly greater than cattle, sheep, and goats. In addition, this value for goats was significantly greater than for sheep and cattle (*P* < 0.001). The annual trends for these parasitic infections in the 5-yr period are shown in Figure 2B. The overall trends were significant for all species (*P* < 0.01). The proportions of condemned liver due to *Dicrocoelium dendriticum* infected animals were 0.2, 0.2, 0.3, and 0.2% for cattle, sheep, goats, and buffalos, respectively. The proportion of liver condemnation due to hydatid disease in goats was significantly greater than cattle, sheep, and buffaloes; its prevalence in cattle and buffaloes was significantly greater than for sheep (*P* < 0.001). The overall trends were significant for all species (Fig. 2C; *P* < 0.001).

**Lungs**

The presence of hydatid cysts in lungs convinced the meat inspectors to reject 3.8, 1.6, 3.6, and 10.8% of cattle, sheep, goats, and buffalos, respectively. The proportion of lung condemnation due to hydatid disease in buffalos was significantly greater than goat, sheep, and cattle; the rejection of cattle lungs was significantly greater than for sheep and goats (*P* < 0.01). The annual trends for these parasitic infections in the 5-yr period are shown in Figure 3. The overall trends were significant for all species (*P* < 0.001).

**Carcasses**

Each time a carcass of sheep, cattle, or buffalo was rejected, it was because of parasitic infection. Over the entire survey period, 10 (0.01%) of the inspected cattle carcasses and 9 (0.04%) of the inspected buffalo carcasses were condemned because of the presence of *Taenia* sp. cysticerci in the muscles. One of the inspected sheep carcasses and 58 of the inspected buffalos carcasses were rejected because *Sarcocystis* sp. cysts were found in the muscles.

**Economic losses**

The total value of the meat and offal lost because of parasite-related condemnation in the study district over the 5-yr study period was estimated to be $1,148,181 (U.S.) (based on market...
Echinococciasis. In the present study, hydatid cysts were found in the total burden (and threat to the local human population) posed by the slaughtered animals are mainly young, the prevalence of Torgerson et al. (1998) reported prevalence in 1-, 2-, and 3-yr-old al., 1998; Lahmar et al., 1999), the abattoir records analyzed here be highly dependent on the age of the potential host (Torgerson et

Grasses. Although the prevalence of echinococciasis is known to be due to a difference in genotypes of E. granulosus that infect E. granulosus liver, but this may be due to a difference in genotypes of E. granulosus that infect goats and sheep (Varastas et al., 2007). Moreover, the grazing behavior of goats is such that the roots of grass are grazed as well as the leaves, but sheep normally graze just the top parts of the parasite lesion observed in ovine and buffalo muscles from Ahwaz were caused by Sarcocystis sp. cysts that were seen in low numbers of the slaughtered sheep and buffaloes, whereas those observed in sheep meat north of Khorasan Province exhibited higher prevalence (Borji and Parandeh, 2010). No Sarcocystis cysts were detected in any of the slaughtered cattle, but this result is based only on macroscopic examinations by meat inspectors. Recently, Nourollahi Fard et al. (2009) examined 480 cattle from Kerman, in south-central Iran; although they did not detect Sarcocystis sp. cysts by initial gross examination in any of the animals, further investigation with the use of tissue digestion and microscopy revealed infection in all of the macroscopically clean animals. Prevalence of cattle cysticercosis in the present study (0.01%) was lower than numbers reported in other regions of Iran (Oryan et al., 1994; Khani, 2010), but higher than those reported from north of Khorasan Province (Borji and Parandeh, 2010). There are indications that the prevalence of cysticercosis and sarcocystosis (detectable by macroscopic examination) in the cattle and sheep brought to abattoir in the study area have decreased over the last 5 or 6 yr. The elimination of stray dogs in the national antirabies program and an increasing awareness of consumers about disease risks may have led to these improvements.

Figure 3. Annual trend of lung condemnation because of hydatid cyst infection in Ahwaz abattoirs from 2006–2011.

Discussion

This survey illustrated the usefulness of meat inspection records in monitoring disease conditions and demonstrated possible annual trends. However, it must be remembered that the actual prevalence of the infection in slaughtered animals may be underestimated due to potentially inadequate meat inspection, rapid slaughter rates, and substandard training of inspectors. The present results, which provide useful baseline data for any future attempt at controlling the parasites involved, indicate that, in Khuzestan Province, several helminths (particularly E. granulosus) cause considerable economic loss because infected organs and flesh must be condemned.

The prevalence of E. granulosus infection recorded in the present study were, in general, lower than those reported from other regions of Iran (Oryan et al., 1994; Ansari-Lari, 2005; Arbabi and Hooshyar, 2006; Daryani et al., 2007; Borji and Parandeh, 2010; Ahmadi and Moshrefehkhar, 2011; Borji et al., 2012) and its neighbor countries, i.e., Saudi Arabia (Ibrahim, 2010), Iraq (Saeed et al., 2000), and Jordan (Kamhawi et al., 1995). Interestingly, slaughtered goats were almost 3-fold more likely to possess hydatid cysts as compared to sheep, but this may be due to a difference in genotypes of E. granulosus that infect goats and sheep (Varastas et al., 2007). Moreover, the grazing behavior of goats is such that the roots of grass are grazed as well as the leaves, but sheep normally graze just the top parts of the parasites involved, indicate that, in the present results, which provide useful baseline data for any future attempt at controlling the parasites involved, indicate that, in Khuzestan Province, several helminths (particularly E. granulosus) cause considerable economic loss because infected organs and flesh must be condemned.

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Figure 3. Annual trend of lung condemnation because of hydatid cyst infection in Ahwaz abattoirs from 2006–2011.
In conclusion, in the present study area, parasites were found to be responsible for 54.4% of offal/carcass condemnations and an associated economic loss approaching $1.2 million. Current estimation of the economic loss caused by parasites here is a gross underestimate of the total financial loss as it does not consider premature deaths, body weight losses, and suboptimal milk and wool yields (Perry and Randolph, 1999). Thus, in spite of the fact that the losses resulted from parasite-related meat condemnation are probably too low to justify a region-wide campaign for the treatment of livestock with anthelmintics, public health considerations are foremost important and may be a rationale to deploy in an anthelmintic campaign.

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LITERATURE CITED


