A Seasonal Survey on the Helminths Infections of the Ruminants Slaughtered in the Abattoirs of Mazandaran Province, Northern Iran

Bahman Rahimi Esboei a *, Iraj Mobedi b, Azadeh Mizani c, Roghaye Zare d, Hossein Vazini e

a. Department of Parasitology and Mycology, School of Medicine, Tonekabon Branch, Islamic Azad University, Tonekabon, Iran.
b. Department of Parasitology and Mycology, School of Public Health, Tehran University of Medical Science, Tehran, Iran.
c. Department of Parasitology and Mycology, School of Medicine, Mazandaran University of Medical Science, Sari, Iran.
d. Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Science, Tehran, Iran.
e. Department, Basic Sciences Faculty, Hamedan Branch, Islamic Azad University, Hamedan, Iran.

*Corresponding author: Department of Parasitology and Mycology, School of Medicine, Tonekabon Branch, Islamic Azad University, Tonekabon, Iran. Postal code: 4719114645. E-mail address: Bahman5164@yahoo.com

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A B S T R A C T

Background: Gastrointestinal infections in ruminants are a major cause of economic losses. The present study aimed to evaluate the prevalence and seasonal variations of gastrointestinal helminth parasitic infections in the slaughtered animals in Mazandaran province, northern Iran.

Methods: This descriptive study was conducted on 300 cattle ruminants (sheep and goats) in Mazandaran province during September 2015-March 2017. The animals were assessed using parasitological methods. The contents of abomasa, small intestine, muscles, and liver were evaluated macroscopically and microscopically.

Results: Among 300 ruminants, 178 (59.33%) were positive for various species of gastrointestinal helminthes, including T. colubriformis, O. circumcincta, M. marshalli, H. contortus, Habronema spp., P. skrjabini, T. saginata, Echinococcus spp., Fasciola spp., and Dicrocoelium spp. Babol was the most infected city (P = 0.001), and spring and summer had higher infection rates. Females were significantly more infected than males, and the animals aged more than nine months were infected more commonly than younger animals (P < 0.05).

Conclusion: According to the results, the rate of gastrointestinal helminth infection was relatively high among the slaughtered ruminants in northern Iran in terms of economic and zoonotic importance, which threatens animal production and public health.

1. Introduction

Ruminants are sources of animal hides, skin, and protein, supplying most of the daily meat and products to humans that are reared in traditional systems in many countries. Furthermore, animal wastes play a key role in agriculture [1]. Clinical and sub-clinical helminths diseases adversely affect the productive and reproductive potential of domesticated livestock. Gastrointestinal nematodes lead to the significant reduction of appetite, deterioration of physical conditions, anemia, hypoproteinemia, reduced digestive absorptive efficiency, and other pathogenic complications and even death in ruminants [2-5], which imposes severe losses on the economies of ranchers and the country in general [6].
Gastrointestinal nematodes are prevalent in Iran, especially in Mazandaran district and many other areas of the country [7]. The frequency of gastrointestinal helminths is associated with agroclimatic circumstances such as the quantity and quality of the field, temperature, humidity, rainfall, and grazing behavior of animals [8]. Another influential factor in this regard is the seasonal changes in the relative proportion of these animals in several environmental zones across the world [9]. Data on the occurrence and scattering of various species of ruminant gastrointestinal nematodes are essential to the design of control plans.

Given the economic and health importance of intestinal nematodes in domestic animals and lack of comprehensive data in this regard in Iran, the present study aimed to investigate the prevalence and seasonal variations of different gastrointestinal helminth parasitic infections in the slaughtered cattle (sheep and goats) in the abattoirs of Mazandaran province in northern Iran and propose the optimal solutions to restrict nematode infection in these animals to help with the further studies.

2. Materials and Methods

2.1. Study Area

This retrospective study was conducted in Mazandaran province, located in the north of Iran. Mazandaran province covers an area of 23,831 square kilometers and is downward to the Caspian Sea, bordering with Golestan (northeast), Guilan (northwest), and Tehran provinces (south) with the latitude of 36°15′N-36°45′N and longitude of 52°15′E-53°E. Mazandaran province plays a pivotal role in the replacement of populations and travelers and has diverse geographical conditions (hills, valleys, and plains). The climate of the area is sub-humid to humid, with the yearly rainfall range of 718-1,274 millimeters [10].

2.2. Sample Collection

Samples collected weekly from 300 cattle (sheep and goats) during September 2015–March 2017. Sampling was performed at the local abattoirs of five regions in Mazandaran province, including Babol, Amol, Sari, Nowshahr, and Behshahr (Table 1). The age, sex, hosts, season, type of breeding, and place of sampling were recorded. The abomasum, small intestine, liver, and various body tissues of the animals were transferred to the laboratory and examined within five hours after slaughter. The abomasum and small intestine were opened, their contents were concentrated over a 100-mesh sieve, and the entire sieve contents were examined microscopically. In addition, the mucosa were observed and scratched meticulously to remove any adhering worms, and the muscles and livers were also examined.

2.3. Sample Examination

The washing process was entirely surveyed to find parasites. The identification of the parasites was completed based on numerous morphological and morphometric factors, such as the total body length, spicule, vulval flap, synlophe patterns, forms of the dorsal ray, cephalic structures, structure of the copulatory bursa, cervical papillae, and gubernaculum observations [11].

2.4. Statistical Analysis

Data analysis was performed in SPSS version 22 using descriptive statistics (frequency and percentage). In addition, Chi-square and Fisher’s exact test were used to assess the differences in the cities, seasons, sex, age groups, animals, and types of breeding. In all the statistical analyses, the alpha value was set at 0.05.

3. Results and Discussion

Among 300 ruminants, 178 cases (59.33%) were positive for various species of gastrointestinal helminths. In different cities in Mazandaran province, the infection rate was observed to be comparatively higher in Babol (P < 0.001) (Table 1). Furthermore, the obtained results indicated that the infection rate was higher in spring and summer. Table 1 shows the distribution of the helminths parasites of the slaughtered animals in terms of gender.

According to the findings, the prevalence of nematodes and trematodes was significantly higher in females. In addition, the associations between age, animals, breeding types, and three types of parasites were considered significant (P < 0.05). The prevalence of helminths in terms of age indicated that the prevalence rate of the infection was higher in the animals aged more than nine months compared to the younger animals. The cattle were observed to be more infected with all types of parasites, while industrial breeding was associated with the lower prevalence of the infection as opposed to traditional breeding (Table 1).

Most of the studies regarding the evaluation of parasitic infections in abattoirs have been based on the helminthic diseases caused by nematodes, cestodes, and trematodes, and data is scarce on protozoan infections [12-13]. In the current research, 40.7% of the ruminants were infected with single or mixed endoparasites. We assessed cows, sheep, and goats, and the parasite rate varied among different ruminants. Consistent with the findings of Eslami et al. (1997), the highest infection rate was observed in cows [14].

The transmission of parasitic diseases is significantly associated with the climate.

According to the information in Table 1, the prevalence of parasitic infections was higher in summer and spring, and a significant difference was observed between nematodes and season (P = 0.014). However, the associations of trematode (P = 0.076) and cestode infections (P = 0.281) with seasons were not considered significant. In the infective stages, larvae urgently need moisture and optimal temperature for growth and survival in the pasture. Extremely hot or extremely low temperatures cause unfavorable conditions for the endurance and growth of parasitic larvae, thereby leading to the poor availability of infective larvae in the pasture. Therefore, summer and winter are probably not suitable for parasite transmission [15].

In a similar study, Radfar et al. (2011) reported that the prevalence of parasitic infections during autumn and winter was significantly higher compared to summer (P < 0.05) [16]. In another study conducted by Bana and Sultanah (2009), autumn as a rainy season was observed to have the highest incidence, while the infection rate was moderate during spring and summer (P < 0.05) [17].
In the present study, the nematode and trematode infection rate significantly differed between males and females \((P = 0.002\) and \(P = 0.014\), respectively) (Table 1), which is inconsistent with the findings of Bano and Sultana (2009), Murat et al. (2009), and Yahaya et al. (2014) [9, 17, 18].

According to the current research, the breeding type of the ruminants was directly correlated with the rate of parasitic infections. Cows are mostly kept indoors in industrial farms where there is no grazing in pasturage, and mostly the poor hygienic conditions of farms. In traditional farms, animals are completely tethered on common grazing land, which is shared by many herds and other animals. The results of the present study indicated that the prevalence rate of all the parasites in traditional farms was significantly higher than industrial farms \((P < 0.0001)\).

Our findings demonstrated that the ruminants aged more than nine months were significantly more infected than those aged less than nine months. In a similar research, Garedaghi and Fattahi (2014) reported no significant correlations between the prevalence of infections and season, age, and sex [19]. In another study performed by Garedaghi et al. (2013) in Behshahr (Iran), the prevalence rate of infections in old animals was similar to our findings and 11–13% higher than young animals \(1-2\) years [20].

Other studies have reported the prevalence of helminth infections to be within the range of 6.8–82% in Iran and 2.3–86% in other countries [21–24]. In the current research, 73.1% of the cattle, 47.8% of the sheep, and 38.9% of the goats were infected by at least one parasite, and the correlation between parasite infection and type of animals was considered significant \((P < 0.0001)\).

In the present study, the rate of *T. colubriformis* infection was estimated at 38.4% compared to the other nematodes. This rate is higher than the value reported in Pakistan and lower than other regions [25, 26]. In a study in this regard, Marcello et al. (2014) observed that 48% of bovines were infected by *Trichostrongylus* spp. in Thailand [27]. Some of the factors that facilitate the survival of *Trichostrongylus* larvae and transmission of the parasites in Mazandaran province include climatic conditions, deprived farm supervision methods (e.g., structures, fertilizers, watering systems), and mostly the poor hygienic conditions of farms. However, we observed no significant difference between *Trichostrongylus* prevalence and type of hosts, with the highest rate recorded in the sheep (17.77%), followed by the cattle \(17.30\)%, and the lowest prevalence was recorded in the goats \(12.96\)%. In this regard, Ntonifor et al. (2013) reported the prevalence rate of *Trichostrongylus* spp. to be 55.8%, 28.8%, and 9.7% in goats, sheep, and cattle, respectively [28]. On the other hand, Gorski et al. (2004) stated that 21.5% of sheep were infected by *Trichostrongylus* in Poland [29].

*Marshallagia marshalli* is an ostertagia nematode in the abomasum of ruminants. In the present study, 16.66% of the sheep and goats and 17.94% of the cattle had *M. marshalli* infection. Among various species of nematodes in Iran, *M. marshalli* is the major cause of gastrointestinal helminthes in ruminants [14].

### Table 1: Prevalence of total helminthic infections in terms of cities, season, sex, age, animals, and type of breeding

| Parameters | Sample Size | Nematode N (%) | Cestoda N (%) | Trematode N (%) | Total infection N (%) |
|------------|-------------|----------------|---------------|-----------------|-----------------------|
| City       |             |                |               |                 |                       |
| Babol      | 100         | 64 (64.0)      | 11 (11.0)     | 21 (21.0)       | 69 (69.0)             |
| Amol       | 41          | 12 (29.3)      | 4 (9.9)       | 8 (19.5)        | 20 (48.8)             |
| Sari       | 50          | 21 (35.6)      | 8 (13.6)      | 10 (16.0)       | 35 (55.3)             |
| Behshahr   | 50          | 13 (26.0)      | 4 (8.0)       | 13 (26.0)       | 21 (42.0)             |
| Nowshahr   | 50          | 20 (40.0)      | 8 (16.0)      | 11 (22.0)       | 33 (66.0)             |
| *P*-value* |             |                | 0.0001        | 0.757           | 0.0841                |
| **Season** |             |                |               |                 |                       |
| Spring     | 71          | 36 (50.7)      | 7 (9.9)       | 9 (12.7)        | 41 (57.7)             |
| Summer     | 106         | 55 (50.5)      | 15 (13.8)     | 31 (28.4)       | 76 (65.1)             |
| Autumn     | 64          | 18 (28.1)      | 10 (15.6)     | 12 (18.8)       | 35 (54.7)             |
| Winter     | 56          | 21 (37.5)      | 3 (5.4)       | 11 (19.6)       | 31 (55.4)             |
| *P*-value* |             |                | 0.014         | 0.281           | 0.076                 |
| **Sex**    |             |                |               |                 |                       |
| Male       | 146         | 50 (34.2)      | 12 (88.2)     | 22 (15.1)       | 68 (46.6)             |
| Female     | 154         | 80 (51.9)      | 23 (14.9)     | 41 (26.6)       | 110 (71.4)            |
| *P*-value* |             |                | <0.0001       | 0.070           | <0.0001               |
| **Age**    |             |                |               |                 |                       |
| <9 Months  | 157         | 48 (30.6)      | 12 (07.6)     | 19 (12.1)       | 66 (42.0)             |
| >9 Months  | 143         | 82 (57.3)      | 23 (16.1)     | 44 (30.8)       | 112 (78.3)            |
| *P*-value* |             |                | <0.0001       | 0.023           | <0.0001               |
| **Animal** |             |                |               |                 |                       |
| Cattle     | 156         | 78 (50.0)      | 27 (17.3)     | 42 (26.9)       | 114 (73.1)            |
| Sheep      | 90          | 37 (41.1)      | 7 (07.8)      | 13 (14.4)       | 43 (47.8)             |
| Goat       | 54          | 15 (27.8)      | 1 (01.9)      | 8 (14.8)        | 21 (38.9)             |
| *P*-value* |             |                | <0.0001       | 0.004           | <0.0001               |
| **Type of Breeding** |          |                |               |                 |                       |
| Industrial | 135         | 12 (08.9)      | 3 (02.2)      | 16 (11.9)       | 26 (19.3)             |
| Traditional| 165         | 118 (71.5)     | 32 (19.4)     | 47 (28.5)       | 152 (92.1)            |
| *P*-value* |             |                | <0.0001       | <0.0001         | <0.0001               |
| Total      | 300         | 170 (56.7)     | 256 (88.3)    | 237 (79.0)      | 122 (40.7)            |

*Pearson's Chi-squared test*
On the same note, Bentounsi et al. (2007) have reported the prevalence rate of M. marshalli infection to be 10% and 85% in Kazakhstan and Algeria, respectively [30].

According to the current research, the prevalence rate of M. marshalli infection to be 10% and 85% in Kazakhstan and Algeria, respectively [30]. During 1985-2004, Dalimi et al. (2002) reported hepatica, while the cattle (26.9%) were significantly more present study, 41.3% of the cases were infected by F. hepatica, and 34.6% in cattle, sheep, goats, and camels, respectively [35]. In the present study, H. contortus infection was detected in 11.2% of the animals. Our findings in this are in line with the study by Nabila (2014), which indicated the H. contortus infection rate to be 9.18% in goats in Saudi Arabia [36], while inconsistent with the findings of Gadahi with the reported prevalence rate of 12.8% [31]. Furthermore, Kingsely et al. (2013) have performed statistical analysis.

Liver flukes such as F. hepatica and D. dendriticum are common helminthic parasites of ruminants in many countries [38]. Several reports have demonstrated the extensive distribution of fascioliasis in Iran [14]. In the present study, 41.3% of the cases were infected by F. hepatica, while the cattle (26.9%) were significantly more infected compared to the Sheep (14.4%) and goats (14.8%) (P < 0.032). During 1985-2004, Dalimi et al. (2002) reported the prevalence rate of fascioliasis to be 17.8%, 19%, 11.5%, and 34.6% in cattle, sheep, goats, and camels, respectively [39].

Similar to most of the studies in this regard, our findings showed that the infection rate of F. hepatica (8.66%) was higher than D. dendriticum (5.66%), which could be due to the complexity of the life cycle and resistance of anthelmintic agents by D. dendriticum [38,40]. In the current research, 10% of the animals were infected by hydatid cyst, and consistent with a study conducted on turkey liver (4%), the lungs of the animals were more infected (3%) compared to the other organs [18].

4. Conclusion

According to the results, the rate of gastrointestinal helminth infection was moderately high considering the economic and zoonotic importance in the slaughtered ruminants in northern Iran, which could adversely affect animal production and public health. To diminish these complications, proper anthelmintic regimens and control programs are recommended in ruminants, along with raising awareness regarding public health. Moreover, it is essential to monitor the gastrointestinal parasites of ruminants in order to improve animal production and public health in Iran.

Authors' Contributions

B.R.E., performed laboratory works, I.M., designed the study as A.M., revised the manuscript, and R.Z., and H.V., performed statistical analysis.

Conflict of Interest

The Authors declare that there is no conflict of interest.

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Table 2: Helminthic parasites isolated from cattle, sheep, and goat in mazandaran province, northern iran

| Parasite                  | Animal          | Cattle N (%) | Sheep N (%) | Goat N (%) | Total N (%) |
|---------------------------|-----------------|--------------|-------------|------------|-------------|
| Nematode                  |                 | 27 (25.7)    | 16 (30.8)   | 4 (18.2)   | 50 (27.9)   |
| O. circumcincta           |                 | 12 (11.4)    | 7 (13.5)    | 9 (40.9)   | 23 (12.8)   |
| M. marshalli              |                 | 28 (26.7)    | 15 (28.8)   | 0 (00.0)   | 52 (29.1)   |
| H. contortus              |                 | 17 (16.2)    | 3 (05.8)    | 2 (09.1)   | 20 (11.2)   |
| M. marshalli + O. circumcincta |         | 13 (12.4)    | 6 (11.5)    | 0 (00.0)   | 21 (11.7)   |
| Habronema                 |                 | 1 (00.9)     | 1 (01.9)    | 0 (00.0)   | 2 (01.1)    |
| H. contortus + M. marshalli + O. circumcincta | 6 (05.7) | 4 (07.7) | 0 (00.0) | 10 (05.6) | |
| Cestoda                   |                 | 5 (18.5)     | 4 (00.0)    | 1 (100.0)  | 5 (14.3)    |
| T. saginata               |                 | 7 (100.0)    | 3 (37.5)    | 30 (85.7)  |
| Hydatid Cyst              |                 | 19 (45.2)    | 4 (30.8)    | 2 (25.0)   | 26 (41.3)   |
| Dicrocelium               |                 | 12 (28.6)    | 3 (21.3)    | 3 (37.5)   | 17 (27.0)   |
| Fasciola + Dicrocelium    |                 | 11 (26.2)    | 6 (46.2)    | 4 (18.2)   | 20 (31.7)   |
