

## Seroprevalence of *Neosporosis* in goats and farm dogs at the central Zagros region (Iran)

Freidon Hazrati Kalbi Beki<sup>1</sup>, Hamidreza Azizi<sup>2</sup>, Gholamali Kojouri<sup>3\*</sup>, Yaser Pirali<sup>4</sup>  
and Morteza Hoseininezhad<sup>5</sup>

<sup>1</sup> MSc Graduated of Master Parasitology, Faculty of Veterinary Medicine, Shahrekord University, Shahrekord, Iran

<sup>2</sup> Associate Professor, Department of Pathobiology, Faculty of Veterinary Medicine, Shahrekord University, Shahrekord, Iran

<sup>3</sup> Professor, Department of Clinical Sciences, Faculty of Veterinary Medicine, Shahrekord University, Shahrekord, Iran and Central Laboratory, Shahrekord University, Shahrekord, Iran

<sup>4</sup> Professor, Department of Pathobiology, Faculty of Veterinary Medicine, Shahrekord University, Shahrekord, Iran

<sup>5</sup> Associate Professor, Department of Clinical Sciences, Faculty of Veterinary Medicine, Shahrekord University, Shahrekord, Iran

Received: 14.10.2022

Accepted: 10.07.2023

### Abstract

*Neospora caninum* is a causative agent of abortion, stillbirth, and birth of weak neonates in wild and domestic mammalian species. The purpose of this seroprevalence study was to detect *N. caninum* in goats and farm dogs at the central Zagros region. This high altitude region is a mountainous, semi-humid and cold region with average rainfall. For this purpose, blood samples were obtained from 384 goats and 30 farm dogs and the existence of antibodies against *N. caninum* was determined using the commercial indirect ELISA method. The goats were divided into three age groups: less than one and a half years (54 heads), two to three years (163 heads), and more than three years (167 heads), with positive cases confirmed in 12, 40, and 50 heads, respectively. The seroprevalence of *N. caninum* was determined to be 26.56% which the highest rate was belonged to the age group of more than 3 years compared to other age groups. In the last thirty years, *Neosporosis* has been one of the causes of abortion in ruminants and in the present study, it was found that out of 5 female goats with a history of abortion, 3 had antibodies against *Neospora caninum*. In addition, 43.3 percent of farm dogs carried antibody against *Neospora caninum*, which may explain the role of domestic carnivores in *Neosporosis* epidemiology.

**Key words:** Central Zagros, Goat, Dog, *Neospora caninum*, *Neosporosis*

### Introduction

*Neospora caninum* was isolated for the first time from a puppy with congenital encephalomyelitis, and after that its related antibodies were detected in most domestic animals (Bjerkås, Mohn, & Presthus, 1984; Dubey, Schares, & Ortega-Mora, 2007). *N. caninum* is a world wide tissue-cyst-forming parasite, which is referred to as a factor that

reduces reproductive capacity (Von Blumröder et al., 2004). Dogs are the main host of *N. caninum* and play an important role in transmitting the infection to intermediate hosts like ruminants (Gazzonis et al., 2016; Jamal Gharekhani, Yakhchali, & Berahmat, 2020). The fast replicating tachyzoites spread within the definitive host

\* **Corresponding Author:** Gholamali Kojouri, Professor, Department of Clinical Sciences, Faculty of Veterinary Medicine, Shahrekord University, Shahrekord, Iran  
E-mail: [kojouri@sku.ac.ir](mailto:kojouri@sku.ac.ir)



tissues and are responsible for causing acute phase limb paralysis in dogs. With the replacement of tachyzoites and then bradyzoites in the intermediate host, a persistent infectious will be formed (Marugan-Hernandez, 2017). Transmission of *N. caninum* occurs horizontally and vertically, and the clinical signs of infected goats and sheep are limited to abortion and sometimes reduced reproductive performance (Gazzonis et al., 2016). Studies on neosporosis in northeastern and northwestern areas of Iran indicate that 46% and 10.6% of cattle were positive, respectively (Nematollahi, Jaafari, & Moghaddam, 2011; Razmi et al., 2006). A meta-analysis research shows that the risk of abortion in goats with neosporosis is 3.07 time higher than in healthy goats (Rodrigues et al., 2020). Research on Iranian goats neosporosis is limited to the western and southwest areas with seroprevalence of 6.2 and 10.8 percent, respectively (Jamal Gharekhani et al., 2016; Jamal Gharekhani et al., 2020). This difference in neosporosis seroprevalence indicates the involvement of some epidemiological factors. Therefore, the present study designed to determine the prevalence of neosporosis in goats and to find the probable role of altitude on its prevalence in the middle Zagros, which is the highest region of Iran.

Further aims of this study were as follow;

- 1- To determine seroprevalence of neosporosis in farm dogs.
- 2- To investigate the relationship between neosporosis and abortion.
- 3- To investigate the impact of age and gender on *Neospora* prevalence.

## Material and methods

### Management of animals and Experimental Design

Experimental protocols for animal care and use were approved by the guidelines of Shahrekord University (Shahrekord, Iran). This research was carried out on 30 traditional flock from 4 different localities of the central Zagros region.

### Sample collection

A total of 384 blood samples were collected from free *Brucella* goats, which were kept in stables during the winter and stayed outside during the spring and summer. In addition, thirty blood samples were taken from crossbreed farm dogs kept with goats.

According to dental formula animals were also divided into three age groups; less than one and a half years (54 heads), two to three years (163 heads), and more than three years (167 heads). Dogs were also divided into two groups of one year and more than one year old.

### Enzyme-Linked Immunosorbent Assay (ELISA) Method

The indirect ELISA test was performed by commercial kit (ID Screen® Neosporosis indirect multi-species; ID-Vet company, France) and the optical density ( $OD \geq 50/41$ ) of each sample was obtained (Alvarez-García et al., 2013; J Gharekhani et al., 2018).

### Statistical analysis

The data (Mean±SEM) was analyzed by using SPSS 24 program, which included the One way analysis of variance (ANOVA) and Chi-square tests at the  $p < 0.05$  level.

## Results

Cut-off values for goats and dog samples were defined and results were summarized in Tables 1 & 2.

The seroprevalence of *Neospora* in goats over 3 years of age was significantly higher than other age groups ( $p < 0.05$ ). The prevalence of neosporosis showed that older goats were more susceptible than younger ones.

The seropositive dogs were determined to be 43.3%. The highest rate belonged to the age group of more than 1 year compared to youngsters ( $p < 0.05$ ).

It was also found that out of 5 female goats with a history of abortion, 3 had antibodies against *Neospora caninum*.

**Table 1: The effect of age on frequency and relative frequency of goats *Neosporosis* in the central Zagros region**

	1-1.5 years	2-3 years	Over 3 years	Total
Number of goats	54	163	167	384
Frequency of positive cases	12	40 <sup>a</sup>	50 <sup>a, b</sup>	102
Relative frequency	22.22%	24.53%	29.94%	26.56%

<sup>a</sup> Significant to 1-1.5 year,  $P < 0.05$ .<sup>b</sup> Significant to 2-3 years,  $P < 0.001$ .**Table 2: The effect of age on frequency and relative frequency of crossbreed farm dogs *Neosporosis* in the central Zagros region**

	1 year	Over 1 year	Total
Number of Dogs	10	20	30
Frequency of positive cases	3	10 <sup>a</sup>	13
Relative frequency	30%	50%	43.3%

<sup>a</sup> Significant to 1 year,  $P < 0.05$ .

## Discussion

Infection with *Neospora* is more common in cattle and dogs and there are limited reports related to goat neosporosis (Jamal Gharekhani et al., 2020; Reichel, Wahl, & Ellis, 2020). Findings indicate the involvement of *Neospora* infection in increasing the rate of abortion and stillbirth, and therefore it causes a lot of economic losses (Gazzonis et al., 2016; Jamal Gharekhani & Yakhchali, 2019; Razmi, Maleki, Farzaneh, Talebkhan Garoussi, & Fallah, 2007). The purpose of the present study was to detect *Neosporosis* in goats and related farm dogs at the central Zagros region. The seroprevalence of *Neosporosis* in goats and farm dogs was determined to be 26.56 and 43.3 percent with the highest rate belonging to the age group of more than 3 and 1 year compared to other age groups, respectively. There are some conflicting reports regarding the effect of age and geographic region on the *Neospora* seroprevalence. For example, in Spain, its prevalence was related to increasing in age, but in Sweden, the opposite happened (Dubey et al., 2007). Due to our results, the prevalence of goats neosporosis in the

central Zagros region is much higher than other countries and even the estimated rate in Iran (Dubey et al., 2007; Jamal Gharekhani et al., 2016). The history of abortion was also taken into consideration, and 3 of the 5 female goats with a history of abortion had antibodies against *Neospora*. This finding may explain the probable role of *Neospora* in causing abortion and stillbirth, because free brucellosis goats were used for the present study. In general, goats over than 3 years and dogs over than 1 year old had more antibodies against *Neospora* which means older animals immune system reacts better to *Neospora* than the younger ones. The increase in seroprevalence with increasing age is probably related to factors such as increased horizontal transmission (oocysts ingestion), regional statement, and non-selective culling (Bartels et al., 2006; Dubey et al., 2007). Furthermore, 43.3% of farm dogs had positive seroprevalence. This issue indicates the involvement of infected dogs in the horizontal transmission of neosporosis.

## Acknowledgment

The researchers would like to express their gratitude to the graduate studies and the central laboratory of Shahrekord University for the financial and diagnostic support of this study.

## Conflict of interest

Authors declare that they have no conflict of interest.

## Funding

This study was financially sponsored by the Shahrekord University (Shahrekord, Iran).

## References

- Alvarez-García, G., García-Culebras, A., Gutiérrez-Expósito, D., Navarro-Lozano, V., Pastor-Fernández, I., & Ortega-Mora, L. M. (2013). Serological diagnosis of bovine neosporosis: a comparative study of commercially available ELISA tests. *Veterinary parasitology*, *198*(1-2), 85-95.
- Bartels, C., Arnaiz-Seco, J., Ruiz-Santa-Quitera, A., Björkman, C., Frössling, J., Von Blumröder, D., . . . Wouda, W. (2006). Supranational comparison of *Neospora caninum* seroprevalences in cattle in Germany, The Netherlands, Spain and Sweden. *Veterinary parasitology*, *137*(1-2), 17-27.
- Bjerkås, I., Mohn, S., & Presthus, J. (1984). Unidentified cyst-forming sporozoon causing encephalomyelitis and myositis in dogs. *Zeitschrift für Parasitenkunde*, *70*(2), 271-274.
- Dubey, J., Schares, G., & Ortega-Mora. (2007). Epidemiology and control of neosporosis and *Neospora caninum*. *Clinical microbiology reviews*, *20*(2), 323-367.
- Gazzonis, A. L., Garcia, G. A., Zanzani, S. A., Mora, L. M. O., Invernizzi, A., & Manfredi, M. T. (2016). *Neospora caninum* infection in sheep and goats from north-eastern Italy and associated risk factors. *Small Ruminant Research*, *140*, 7-12.
- Gharekhani, J., Esmailnejad, B., Rezaei, H., Yakhchali, M., Heidari, H., & Azhari, M. (2016). Prevalence of anti-*Neospora caninum* antibodies in Iranian goats. *Annals of Parasitology*, *62*(2).
- Gharekhani, J., & Yakhchali, M. (2019). *Neospora caninum* infection in dairy farms with history of abortion in West of Iran. *Veterinary Animal Science*, *8*, 100071.
- Gharekhani, J., Yakhchali, M., & Berahmat, R. (2020). *Neospora caninum* infection in Iran (2004–2020): A review. *Journal of Parasitic Diseases*, *44*(4), 671-686.
- Gharekhani, J., Yakhchali, M., Esmailnejad, B., Mardani, K., Majidi, G., Sohrabei, A., . . . Hazhir Alaei, M. (2018). Seroprevalence and risk factors of *Neospora caninum* and *Toxoplasma gondii* in small ruminants in Southwest of Iran. *Archives of Razi Institute*, *73*(4), 305-310.
- Marugan-Hernandez, V. (2017). *Neospora caninum* and bovine neosporosis: current vaccine research. *Journal of comparative pathology*, *157*(2-3), 193-200.
- Nematollahi, A., Jaafari, R., & Moghaddam, G. (2011). Seroprevalence of *Neospora caninum* infection in dairy cattle in Tabriz, Northwest Iran. *Iranian Journal of Parasitology*, *6*(4), 95.
- Razmi, G. R., Maleki, M., Farzaneh, N., Talebkhan Garoussi, M., & Fallah, A. (2007). First report of *Neospora caninum*-associated bovine abortion in Mashhad area, Iran. *Parasitology Research*, *100*(4), 755-757.
- Razmi, G. R., Mohammadi, G. R., Garrosi, T., Farzaneh, N., Fallah, A., & Maleki, M. (2006). Seroepidemiology of *Neospora caninum* infection in dairy cattle herds in Mashhad area, Iran. *Veterinary parasitology*, *135*(2), 187-189.
- Reichel, M. P., Wahl, L. C., & Ellis, J. T. (2020). Research into *Neospora caninum*—what have we learnt in the last thirty years? *Pathogens*, *9*(6), 505.
- Rodrigues, A. A., Reis, S. S., de Sousa, M. L., da Silva Moraes, E., Garcia, J. L., Nascimento, T. V. C., & da Cunha, I. A. L. (2020). A systematic literature review and meta-analysis of risk factors for *Neospora caninum* seroprevalence in goats. *Preventive Veterinary Medicine*, *185*, 105176.
- Von Blumröder, D., Schares, G., Norton, R., Williams, D. J., Esteban-Redondo, I., Wright, S., Fernández-García, A. (2004). Comparison and standardisation of serological methods for the diagnosis of *Neospora caninum* infection in bovines. *Veterinary parasitology*, *120*(1-2), 11-22.

Received: 14.10.2022

Accepted: 10.07.2023

## شیوع سرمی نئوسپوروز در بز و سگ‌های گله منطقه زاگرس مرکزی

فریدون حضرتی کلبی<sup>۱</sup>، حمیدرضا عزیزی<sup>۲</sup>، غلامعلی کجوری<sup>۳\*</sup>، یاسر پیرعلی<sup>۴</sup> و مرتضی حسینی‌نژاد<sup>۵</sup><sup>۱</sup> فارغ‌التحصیل کارشناسی ارشد انگل‌شناسی، دانشکده دامپزشکی، دانشگاه شهرکرد، شهرکرد، ایران<sup>۲</sup> دانشیار گروه پاتوبیولوژی، دانشکده دامپزشکی، دانشگاه شهرکرد، شهرکرد، ایران<sup>۳</sup> استاد گروه علوم درمانگاهی، دانشکده دامپزشکی، دانشگاه شهرکرد، شهرکرد، ایران و آزمایشگاه مرکزی دانشگاه شهرکرد، شهرکرد، ایران<sup>۴</sup> استاد گروه پاتوبیولوژی، دانشکده دامپزشکی، دانشگاه شهرکرد، شهرکرد، ایران<sup>۵</sup> دانشیار گروه علوم درمانگاهی، دانشکده دامپزشکی، دانشگاه شهرکرد، شهرکرد، ایران

تاریخ پذیرش: ۱۴۰۲/۴/۱۹

تاریخ دریافت: ۱۴۰۱/۷/۲۲

## چکیده

نئوسپورا کانینوم از عوامل سقط جنین، مرده‌زایی و تولد نوزادان ضعیف در پستانداران اهلی و وحشی به شمار می‌آید. هدف از انجام مطالعه حاضر تعیین میزان شیوع سرمی آنتی‌بادی بر علیه نئوسپورا در گله‌های بز و سگ‌های گله در منطقه زاگرس مرکزی بود. بدین منظور نمونه خون از ۳۸۴ رأس بز و ۳۰ قلاده سگ گله اخذ و برای شناسایی آنتی‌بادی بر علیه نئوسپورا از روش الایزای غیرمستقیم بهره گرفته شد. بزها در سه گروه سنی زیر یک و نیم سال (۵۴ رأس)، دو تا سه سال (۱۶۳ رأس) و بیش از سه سال (۱۶۷ رأس) قرار داشتند که حضور آنتی‌بادی بر علیه نئوسپورا به ترتیب در ۱۲، ۴۰ و ۵۰ رأس از آن‌ها به تأیید رسید. بر همین اساس شیوع سرمی آنتی‌بادی بر علیه نئوسپورا در منطقه معادل ۲۶/۵۶ درصد تعیین شد که بیشترین میزان شیوع متعلق به گروه سنی بیش از سه سال نسبت به سایر گروه‌ها بود. در سی سال گذشته نئوسپورا به عنوان یکی از عوامل سقط جنین در نشخوارکنندگان مطرح بوده و در تحقیق حاضر نیز سه رأس از پنج رأس بز با سابقه سقط جنین، از نظر سرمی مثبت گزارش شدند. علاوه بر این ۴۳/۳ درصد از سگ‌های گله آنتی‌بادی بر علیه نئوسپورا را در سرم خود داشتند که نشان دهنده نقش اپیدمیولوژی گوشته‌خواران اهلی در شیوع بیماری در سطح گله‌های بز منطقه است.

کلمات کلیدی: زاگرس مرکزی، بز، سگ، نئوسپورا کانینوم، نئوسپوروز

\* نویسنده مسئول: غلامعلی کجوری، استاد گروه علوم درمانگاهی، دانشکده دامپزشکی، دانشگاه شهرکرد، شهرکرد، ایران و آزمایشگاه مرکزی دانشگاه شهرکرد، شهرکرد، ایران

E-mail: kojouri@sku.ac.ir

© 2020 by the authors. Licensee SCU, Ahvaz, Iran. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0 license) (<http://creativecommons.org/licenses/by-nc/4.0/>).