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PREVALENCE AND ASSOCIATE FACTORS TO THE INFECTION FOR LENTIVIRUS OF SMALL RUMINANTS IN CAPRINE OF TOCANTINS STATE, BRAZIL

Pedro Alves de Moura Sobrinho,[1] Taciana Rabelo Ramalho Ramos,[1] Cláudio Henrique Clemente Fernandes,[1] Ana Claudia Campos,[2] Luciana Menezes Costa[3] e Roberto Soares Castro[4]

1 Veterinary Doctor, PhD in Veterinary Science, Researcher, Fundação Universidade do Tocantins (UNITINSAGRO). Alameda 11, Quadra 108 Sul, lote 03, Palmas-TO, ZIP: 77020 122. E-mail: pedro.am@unitins.br
2 Veterinary Doctor, MSc student of Veterinary Science, Universidade Federal Rural de Pernambuco. Recife - PE.
3 Veterinary Doctor.
4 Adjunct Professor, Veterninary Medicine Department, Universidade Federal Rural de Pernambuco. Recife - PE

ABSTRACT

The aim of this study was to estimate the prevalence of caprine blood reagents to small-ruminant lentiviruses (SRLV), through a non probabilistic sampling of herds in Tocantins State. In order to detect the anti-SRLV antibodies, 843 blood samples were analyzed using the microimmunodiffusion test in agarose gel – MICRO-IDGA. The frequency of blood reagent goats was 2.7% (23/843). Five focus, being two in the city of Araguaína, and one in each of the cities of Babaçulândia, Filadelfia and Miracema do Tocantins had been identified. The results were distributed according to micro-region in the following manner: 10.0 (20/200) and 1.4% (3/207) for the North and Miracema micro-regions, respectively. The Saanen was the breed with the highest percentage of blood reagent animals (11.7%; 7/60), the undefined breed animals 0.6% (2/310) and Anglo-Nubian (3.0%; 14/466). Regarding age, 1.9% (6/314) and 3.2% (17/529) of animals under and over 24 months of age, respectively, tested positive. 2.4% (4/166) of males and 2.8% (19/677) of females tested positive. The SRLV infection occurs at a low prevalence among goats in Tocantins State, affecting mainly animal of the Saanen breed and from the north region.

KEY WORDS: Brazil, CAEV, epidemiology, microimmunodiffusion.

RESUMO

PREVALÊNCIA E FATORES ASSOCIADOS À INFECÇÃO POR LENTIVÍRUS DE PEQUENOS RUMINANTES EM CAPRINOS NO ESTADO DO TOCANTINS

Objetivando estimar a prevalência de caprinos sororreagentes aos Lentivírus de Pequenos Ruminantes (LVPR), através de uma amostragem não probabilística em rebanhos no Estado do Tocantins, foram analisadas 843 amostras de soros, utilizando o teste de imunodifusão em gel de agarose – MICRO-IDGA para a detecção de anticorpos anti-LVPR. A frequência de animais sororreagentes foi de 2,7% (23/843). Foram identificados 5 focos, sendo dois no município de Araguaína e um em Babaçulândia, Filadélfia e Miracema do Tocantins. De acordo com a região, os resultados foram assim distribuídos: 10,0% (20/200) e 1,4% (3/207) para as microrregiões Norte e Miracema, respectivamente. Entre as raças, a Saanen foi a que apresentou o maior percentual de animais sororreagentes, 11,7% (7/60), os sem raça definida 0,6% (2/310) e a anglo-nubiana 3,0% (14/466). De acordo com a idade, os animais com idade inferior e superior a 24 meses apresentaram 1,9% (6/314) 3,2% (17/529), respectivamente. Os machos apresentaram 2,4% (4/166) de positivos e as fêmeas 2,8% (19/677). Os resultados indicam que os LVPR ocorrem com baixa prevalência no Estado do Tocantins, afetando principalmente animais da raça saanen e da região norte.

Palavras-Chaves: CAEV, microimunodifusão, epidemiologia, Brasil.

INTRODUCTION

The productive chain analysis of national caprine raising has shown a great expansion potential. In this sense, it is essential the concern about the herds´sanitary state, once the sanitary demands for animal commerce have been intesified. This way, an improvent of the instalations hygiene conditions and the assurance of herds free of certain diseases may result in added value to the animals and their products (CASTRO & MELO, 2001).

The absence of a national program of essential genetic improvement for the expansion of milk caprine raising has shown the necessity of importing specialized breeds animals. With the import of these animals that come from European countries, many emergent sanitary problems have been reported, specially small ruminats lentivirosis (SRLV) (CASTRO, et al., 1994; ASSIS & GOUVEIA, 1994).

The SRLV are infecto-contagious diseases of slow evelution, caused by a virus from the Retroviredae family and Lentivirinae subfamiliy, which is presented in four clinical forms: nervous, respiratory, mammary, and articular. The most frequent clinical form is the articular in adult caprines, whereas the leucoencephalomyelitis in broods within one and four months of age is the least frequent (DAWSON, 1980; EAST et al., 1993; CALLADO et al., 2001).

The principal transmission way of the SRLV is throiugh the intake of colostrum or of infected goats´ milk. However, the horizontal transmission may occur through secretions and excretions, contaminated tools and equipments, and long contact between healthy and infected animals (ADAMS et al., 1983; ALVES, 1999; PETERHANS et al., 2004). This infection is insidious presenting the clinical signs within months or years after the infection, whilst most of the animals do not present symptomatology. Nevertheless, the production patterns are affected, specially in milk goats SMITH & CUTLIP, 1988; GREENWOOD, 1995).

In Brazil, the first description of SRLV in caprine was made by MOOJEN et al. (1986) in Rio Grande do Sul State. Serological studies with probabilistic sampling have shown the presence of positive animals in many States, principally in commercial exploration milk herds. The observed prevalences varied from 0.73% to 43.0% in researches in the following States: Pernambuco (SARAIVA NETO et al., 1995), Ceará (PINHEIRO et al., 2001), São Paulo (LEITE et al., 2004), Paraíba (BANDEIRA, 2009), Rio Grande do Norte (SILVA et al., 2005), Bahia (OLIVEIRA et al., 2006), Piauí (SAMPAIO JÚNIOR, 2007), and Rio de Janeiro (MOREIRA et al., 2007).

Considering the growth of caprine raising in Tocantins and the lack of information about SRLV in caprine in the State, the objective of this work was to estimate the prevalence of caprine blood reagents to SRLV in Tocantins State, and to verify whether there is association among microregion, breed, age, sex, raising system and herds with associated species, and the SRLV occurence.

MATERIAL AND METHODS

Tocantins State, with na area of 286,706 Km2, is located in the Northern region of the country, in Legal Amazonia, and hás the geographical coordinates: longitude - 46º 00’ and 51º 00’ of Greenwich and latitude - 05º 00’ and 13º 00’ S. The vegetation is very varied, from cerrado (savanna) meadow, cerradão, rupestrian grassland, to transition equatorial Forest, under gallery forest form. The climate is semi-humid, with average annual temperature of 26oC. Rainfall varies from 1,500mm to 1,800mm/year, and the characterize a distribution which defines two periods: dry from May to August, and rainy from September to May (NASCIMENTO, 2007).

The SRLV prevalence in caprine was estimated based on a non-probabilistic sample study, involving the municipalities of Araguatins, Araguaína, Xambioá, Babaçulandia, Filadélfia, Barra do Ouro, Araguacema, Dois Irmãos do Tocantins, Miracema do Tocantins, Pium, Paraíso, Palmas, Natividade, Dianópolis and Ponte Alta do Bom Jesus (Figure 1). The number of animals used in this research was calculated by the Epi-Info software, version 3.3.2 (DEAN et al., 1992), through the following formula, described by KISH (1965):

$$N = Z \cdot Z [P (1 - P)] / D \cdot D,$$

Where:

N – number of samples to estimate the prevalence in infinite population;

P – expected prevalence (5%);

Z – detemining factor of the 90% reliability level (Z=1.64); and

D – sampling error (25% P)

This way, "N" equal to 818 samples was obtained. The number of collected samples per property varied from 16 to 30, in a total of 843 samples in 29 properties. The animals´ age was estimated based on the number of teeth the animals presented: first change (less than 24 months), and more than two changes (more than 24 months) (JARDIM, 1985).

The blood was collected through vein punction of the jugular, by the use of vacuum system. After the blood clot retraction, the samples were centrifuged at 800g for tem minutes and transfered to freezing tubes (1.5mL), which remained at -20oC until the processing moment.

For the detection of antibodies against SRLV the microtechnique of agar gel immunodiffusion (AGID) was used, by the means of a commercial kit1, composed of antigen, positive pattern serum, and agarose solution at 1% in borate buffer, according the the manufacturer´s recomendations.

For the data analysis, the Pearson´s Chi-Square test or Fisher´s exact test were used, when the conditions for the Chi-Square test utilization were not verified. A 5% significance level was used in the decisions about the statistical tests. The software used for obtaining the statistical calculations was Epi-Info, version 3.2.2 (DEAN et al., 1992).

RESULTS AND DISCUSSION

From the 843 serum samples were examed by the AGID test for the research of antibodies against SRLV, 23 (2.7%) were positive. Five focuses were identified, being two in the municipalities of Araguaina, and one in each of the municipalities of Babaçulândia, Filadélfia and Miracema do Tocantins (Figure 1). From the 29 herds, Five (17.2%) presented at least one blood reagent animal.

The low prevalence found by this research may be possibly explained by the recent herd formation in the State, composed basically by anglo-nubian and undefined breed (UB) animals (UB) that, according to SARAIVA NETO (1995), have presented prevalence level inferior to the one of the European milk breeds. Besides, practices which tend to increase the rist of horizontal transmission, such as feedlot and the use of collective bottle, are not adopted by the researched properties (ADAMS et al., 1983; ALVES, 1999). However, these results are considered important due to possibility of SRLV dissemination to other caprine herds. Moreover, the breeding systems intensification intending to increase productivity might offer conditions for the virus dissemination COSTA et al., 2007).

Blood reagent animals to SRLV were found in two microregions, being 10% among the animals of northern microregion and 1.4% maong the animals from Miracema (Table 1). Such results indicate significant association between the SRLV prevalence and the microregions ($p<0.05$). The high positivity found in the northern microregion is possibly due to fact that the animals belong to exploration herds for Milk production.

In the studied properties only five breeds were reported (Anglo-nubian, Saanen, undefined breed – UB –, Boer and Jamnapari), demonstrating recent adhesion tocaprine raising by the State breeders. It was also verified that the positivity for SRLV was higher among the Saanen animals, with 11.7% (7/60), followed by the Anglo-nubian, 3.0% (14/452), and last by the undefined breed animals (UB), 0.6% (2/310). According to the result analysis, significant association between breed and SRLV occurence was confirmed ($P < 0.05$) (Table 2).

One reason for the smaller prevalence in undefined breed animals (UB) with regards to pure breed animals is possibly related to the mamagement system, because some practices that may increase horizontal transmission, such as feedlot and the use of collective bottles, occasionaly adopted at some properties, are usually employed for the management of pure milk herds (SARAIVA NETO et al., 1995). The presence of SRLV among almost all milk animals may represent a dissemination risk of the agent to the undefined breed animals (UB) (PINHEIRO et al., 2001; BANDEIRA, 2005).

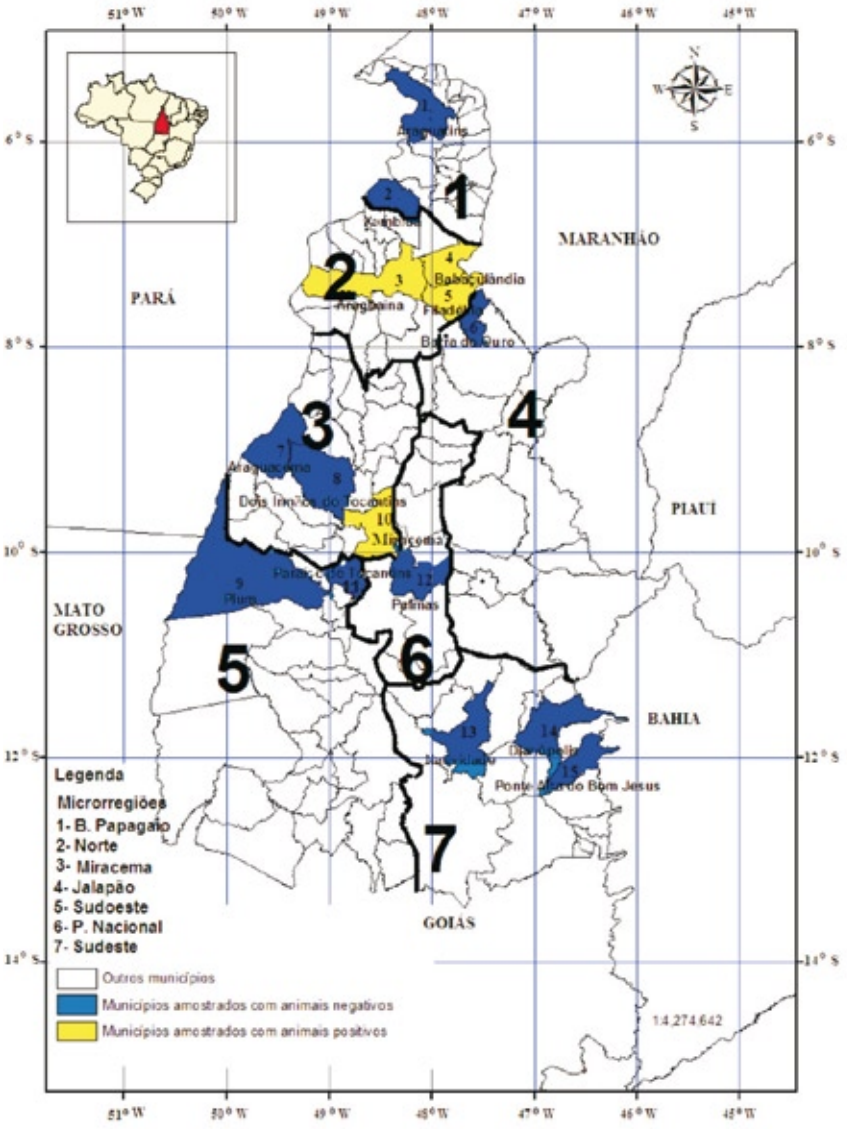

FIGURE 1: Geographical representation of the municipalities in Tocantins State representative of the sample SRLV in caprine.

TABLE 1 - Distribution of caprine positive to agar gel microimmunodiffusion (MICRO-AGID) for small ruminants lentiviruses, per microregion in caprine herds from Tocantins State, 2006.

		MICRO – AGID			
Microregion		Positive		Negative	
	N	n	%	n	%
Bico do Papagaio	46	0	0,0	46	100,0
North	200	20	10,0	180	90,0
Jalapão	60	0	0,0	60	100,0
Miracema	207	3	1,4	204	98,6
Southwest	90	0	0,0	90	100,0
Porto Nacional	150	0	0,0	150	100,0
Southeast	90	0	0,0	90	100,0
Total	843	23	2,7	820	97,3

P = 0.0001, CHI-Square test

TABLE 2 - Distribution of caprine positive to agar gel microimmunodiffusion (MICRO-AGID) for small ruminants lentiviruses, per breed from Tocantins State, 2006.

	MICRO – AGID				
Breed		Positive		Negative	
	N	n	%	n	%
UB	310	2	0,6	308	99,4
Anglo-nubian	466	14	3,0	452	97,0
Saanen	60	7	11,7	53	88,3
Total	843	23	2,7	813	97,3

P = 0.0001, by Chi-Square test

As regards the animals´age, the prevalence of positive blood reagents to SRLV was 3.2% among animals within 2nd and 4th change, and 1.9% among the animals in the age group until 1st change. The results analysis did not prove significant association between age group and SRLV occurence (p>0.05) (Table 3). The superiority of positivity between older animlas may be explained by a longer exposure time to the virus, due to the slow evolution of the infirmity (MCGUIRE, 1987). A long time is necessary for the animal to produce levels of antibody which are detectable at AGID test, what may occur 18 months after detection by PCR (polymerase chain reaction) or even it may never occur (WAGTER et al., 1998).

Table 4 shows the results of the serological tests relative to the animal´s sex. Thje prevalence of positive animals to SRLV was only 0.4% higher among the females than among the males (2.8% x 2.4%) and a significant association was not proved between sex and SRLV occurence (p>0.05). These results confirm the ones by CRAWFORD & ADAMS (1981) and SARAIVA NETO (1995), Who stated that there were no factors related to the sex that would predispose the animal to SRLV infection. However, FERNANDES et al. (2003) reported that due to the longer time the females remain together in the herd and in the same stall, while reproductive males remain in separated stalls, there can be a higher dissemination of the virus among the females.

According to the management system, positive animals were observed in 6.6% (1/15) and 28.4% (4/14) of the properties that adopt extensive and semi extensibe breeding, respectively (Table 5). The frequency of positive animals was higher in the semi-extensive system, but there was no significant difference between breeding system and the occurence of positive animals per herd (p > 0.05). The breeding system is an important factor to be considered, once the agglomeration favours the SRLV dissemination (CASTRO & MELO, 2001; FERNANDES et al., 2003).

TABLE 3 - Distribution of caprine positive to agar gel microimmunodiffusion (MICRO-AGID) for small ruminants lentiviruses, per age (change) from Tocantins State, 2006.

	MICRO – AGID				
Age (change)		Positive		Negative	
	N	n	%	n	%
Until 1st	314	6	1,9	308	98,1
From 2nd to 4th	529	17	3,2	512	96,8
Total	843	23	2,7	820	97,3

P = 0.2616, by Chi-square test

TABLE 4 – Distribution of caprine positive to agar gel microimmunodiffusion (MICRO-AGID) for small ruminants lentiviruses, per sex from Tocantins State, 2006.

		MICRO – AGID			
Sex		Positive		Negative	
	N	n	%	n	%
Males	166	4	2,4	162	4
Females	677	19	2,8	658	19
Total	843	23	2,7	820	23

P= 1.000, by Fisher exact´s test.

TABLE 5 - Distribution of caprine positive to agar gel microimmunodiffusion (MICRO-AGID) for small ruminants lentiviruses, per breeding system from Tocantins State, 2006.

		MICRO – AGID			
Breeding system		Positive		Negative	
	N herd	n	%	n	%
Extensive	15	1	6,6	14	93,4
Semi-Extensive	14	4	28,6	10	71,4
Total	29	5	17,2	24	82,8

P = 0.1432, by Fisher exact´s test.

In Table 6 the results relative to herds with or without species association are found. In the herds where caprine are reared the percentage of blood reagent animals was of 18.7% (3/16), and in the herds with association of caprine and ovine it was of 15% (2/15). There was no significant association ($p > 0.05$) between the caprine + ovine associated management or the single management of caprine and the occurence of SRLV in the studied herds (Table 6). However, filogenetic studies indicate the existance of transmission between caprine and ovine (OLIVER et al., 1985; CASTRO et al., 1999; SHAH et al., 2004).

TABLE 6 - Distribution of caprine positive to agar gel microimmunodiffusion (MICRO-AGID) for small ruminants lentiviruses, per herd with species association from Tocantins State, 2006.

		AGID	
Species	N Herd	Positive n (%)	Negative n (%)
Caprine	16	3 (18,7)	13 (81,3)
Caprine + Ovine	13	2 (15,4)	11 (84,6)
Total	29	5 (17,2)	24 (82,8)

P = 0.6038, by Fisher exact´s test.

CONCLUSION

The SRLV is present, with low prevalence, in caprine herds form Tocantins State, mainly in the north microregion and in animals of the Saanen breed. These data confirm the importance of implementing measures to control small ruminants lentiviruses in the State.

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REFERENCES

ADAMS, D. S.; KLEVJER-ANDERSON, P.; CARLSON, B. S.; MCGUIRE, T. C. Transmission and control of caprine arthritis-encephalitis virus. **American Journal Veterinary Research**, v. 44, p.1670-1675, 1983.

ALVES, F. S. F. **Fatores de risco e transmissão da artrite encefalite caprina a vírus**. Sobral: Embrapa Caprino, 1999. 15 p. (Embrapa Caprino. Documento, 29).

ASSIS, A. P. M. V.; GOUVEIA, A. M. G. Evidência de *lentivirus* (Maedi-Visna/CAE) em rebanho nos Estados de MG, RJ, BA e CE. In: CONGRESSO BRASILEIRO DE MEDICINA VETERINÁRIA, 23., 1994, Recife. **Anais**... Recife: Sociedade Brasileira de Medicina Veterinária, l994. p. 104.

BANDEIRA, D. A.; CASTRO, R.; AZEVEDO, E. O.; MELO, L. S. S.; MELO, C. B. Seroprevalence of caprine arthritis-encephalitis virus in goats in the Cariri region, Paraiba state, Brazil. **The Veterinary Journal**, v. 180, p. 399-401, 2009.

CALLADO, A. K. C.; CASTRO, R. S.; TEIXEIRA, M. F. S. Lentivírus de pequenos ruminantes (AEV e Maedi-Visna): revisão e perspectivas. **Pesquisa Veterinária Brasileira**, v. 21, n. 3, p. 87-97, 2001.

CASTRO, R. S.; GREENLAND, T.; LEITE, R. C.; GOUVEIA, A. M. J.; MORNEX, J. F.; CORDIER, G. Conserved sequence motifs involving the *tat* reading frame of Brazilian caprine lentiviruses indicate affiliations to both caprine arthritisencephalitis virus and visna-maedi virus. **Journal General Virology**, v. 80, p. 1583-1589, 1999.

CASTRO, R. S.; MELO, L. E. H. CAEV e Maedi-Visna: importância na saúde e produtividade de caprinos e ovinos e a necessidade de seu controle no Nordeste brasileiro. **Ciência Veterinária nos Trópicos**, v. 4, n. 2/3, p. 315-320, 2001.

CASTRO, R. S.; NASCIMENTO, S. A.; R. C.; ABREU, S. R. Evidência sorológica da infecção pelo vírus da artrite encefalite caprina em caprinos leiteiros no Estado de Pernambuco. **Arquivo Brasileiro de Medicina Veterinária e Zootecnia**, v. 46, n. 5, p. 571-572, 1994.

COSTA, L. S. P.; LIMA, P. P.; CALLADO, A. K. C.; NASCIMENTO, S. A.; CASTRO, R. S. Lentivírus de pequenos ruminantes em ovinos Santa Inês: isolamento, identificação pela PCR e inquérito sorológico no Estado de Pernambuco. **Arquivo Instituto Biológico**, v. 74, n. 1, p. 11-16, 2007.

CRAWFORD, T. B.; ADAMS, D. S. Caprine arthritis-encephalitis: clinical features and presence of antibody in selected populations. **Journal of American Veterinary Medicine Association**, v. 178, p. 713-719, 1981.

DAWSON, M. Pathogenesis of maedi visna. **Veterinary Record**, v. 120, p. 451-454, 1980.

DEAN, A. G.; DEAN, J. A.; BURTON, A. H. E.; DICKER R. C. **Epi info, version 6**: a word processing, database and statistic program for epidemiology on micro-computers. Atlanta, Georgia, Center for Disease Control, 1992. 302 p. Disponível em: http://www.cdc.gov/EpiInfo/biblio.htm

EAST, N. E.; ROWE, W. J.; DAHLBERG, J. E.; THEILEN, G. H.; PEDERSOEN, N. C. Models of transmission of caprine arthritis encefalites virus infection. **Small Ruminant**, v. 10, p. 251-262,1993.

FERNANDES, M. A.; ARAÚJO, W. P.; CASTRO, R. S. Prevalência da infecção pelo vírus Maedi-Visna em ovinos da microregião grande São Paulo. **Ciência Veterinária nos Trópicos**, v. 6, n. 1, p. 23-28, 2003.

GREENWOOD, P. L. Effects of caprine artrhitis-encephalitis virus on productivity and health of dairy goats in New South Wales, Australia. **Preventive Veterinary Medicine**, v. 22, p. 71-78, 1995.

JARDIM, W. R. **Criação de caprinos**. 11. ed. São Paulo: Nobel, 1985. 238 p.

KISH, L. **Survey sampling**. New York: John Wiley e Sons Inc, 1965. 634 p.

LEITE, B. L. S.; MODOLO, J. R.; PADOVANI, C. R.; STASCHISINI, A. V. M; CASTRO, R. S.; SIMÕES, L. B. Avaliação da taxa de ocorrência da artrite encefalite caprina a vírus pelas regionais do Escritório de Defesa Agropecuária do Estado de São Paulo, Brasil, e seu mapeamento por meio de sistemas de informações geográficas. **Arquivo Instituto Biológico**, v. 71, n. 1, p. 21-26, 2004.

MCGUIRE, T. C. The imune response to viral antigens as adeterminant of arthritis in caprine arthritis-encephalitis infection. **Veterinary Immunology and Immunopathology**, v. 17, n. 1, p. 465-470, 1987.

MOOJEN, V.; SOARES, H. C.; RAVEZZOLO, A. P.; PIZZOL, M.; GOMES, M. Evidência de infecção pelo Lentivirus (Madei-Visna/artrite-encefalite caprina) em caprinos do Rio Grande do Sul, Brasil. **Arquivos da Faculdade de Veterinária da UFRGS**, v. 14, p. 77-78, 1986.

MOREIRA, M. C.; OELEMANN, W. M. R.; LILENBAUM, W.

Dados sorológicos da artrite encefalite caprina no Estado do Rio de Janeiro e avaliação do uso do índice clínico como ferramenta de diagnóstico. **Revista Brasileira de Medicina Veterinária**, v. 29, n. 2, p. 51-53, 2007.

NASCIMENTO, J. B. **Conhecendo o Tocantins**: história e geografia. 5. ed. Goiânia: ASA, 2007.

OLIVEIRA, M. M. M.; CASTRO, R. S.; CARNEIRO, K. L; NASCIMENTO, S. A.; CALLADO, A. K. C.; ALENCAR, C. S. A.; COSTA, L. S. P. Anticorpos contra lentivírus de pequenos ruminantes em caprinos e ovinos em abatedouros do estado de Pernambuco. **Arquivos Brasileiros de Medicina Veterinária e Zootecnia**, v. 58, n. 5, p. 947-949, 2006.

OLIVER R.; C. A.; McNIVEN, R.; P. W.; ROBATI, G. Infection of lambs with CAEV by feeding milk from infected goats. **Veterinary Record**, v. 19, p. 83-90, 1985.

PETERHANS, E.; GREENLAND, T.; BADIOLA, C.; HARKISS, G.; BERTONI, G.; AMORENA, B.; ELIASZEWICZ, M.; JUSTE, A.; KRABNIG, R.; LAFONT, J. P.; LENIHAN, P.; PETURSSON, G.; PRITCHARD, G. THORLEY, J.; VITU, C.; MORNEX, J. F.; PEPIN, M. Routes of transmission and consequences of small ruminant lentiviruses (SRLVs) infection and eradication schemes. **Veterinary Research**, v. 35, p. 257-274, 2004.

PINHEIRO, R. R.; GOUVEIA, A. M. G.; ALVES, F. S. F. Prevalência da infecção pelo vírus da artrite encefalite caprina no Estado do Ceará, Brasil. **Ciência Rural**, v. 31, p. 449-454. 2001.

SAMPAIO JÚNIOR, A. **Soroprevalência das lentiviroses de pequenos ruminantes em caprinos e ovinos no município de Teresina, Piauí, Brasil**. 2007. 68 f. Dissertação (Mestrado em Ciência Animal) – Universidade Federal do Piauí, Teresina, 2007.

SARAIVA NETO, A. O.; CASTRO, R. S.; BIRGEL, E. H.; NASCIMENTO, S. A. Estudo soro-epidemiológico da artrite encefalite caprina em Pernambuco. **Pesquisa Veterinária Brasileira**, v. 15, n. 4, p. 121-124, 1995.

SHAH, C.; BÖNI, J.; HUDER, J. B.; VOGT. H. R.; MUHLHERR, J.; ZANONNI, R.; MISEREZ,R.; LUTZ, H.; SOHUPBACH, J. Phylogenetic analysis and reclassification of caprine and ovine lentiviruses based on 104 new isolates: evidence for regular sheep-to-goat transmission and world propagation through livestock trade. **Virology**, n. 319, p. 12-26, 2004.

SILVA, J. S.; CASTRO, R. S.; MELO, C. B.; FEIJO, F. M. C. Infecção pelo vírus da artrite encefalite caprina no Rio Grande do Norte. **Arquivo Brasileiro de Veterinária e Zootecnia**, v. 57, n. 6, p. 726-731, 2005.

SMITH, M.C.; CUTLIP, R. Effects of infection with caprine arthritis-encephalitis virus on milk production in goats. **Journal of American Veterinary Medicine Association**, v. 193, p. 63-67, 1988.

WAGTER, L. H.; JANSEN, A.; BLEUMINK-PLUYM, N. M.; LENSTRA, J.A.; HOUWERS, D. J. PCR detection of lentiviral *gag* segments DNA in the white blood cells of sheep and goats. **Veterinary Research Communications**, v. 22, p. 355-362, 1998.

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