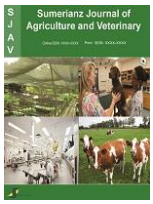
*Sumerianz Journal of Agriculture and Veterinary, 2018, Vol. 1, No. 3, pp. 64-69*
*ISSN(e): 2617-3077, ISSN(p): 2617-3131*
*Website: https://www.sumerianz.com*


Original Article Open Access

# Occurrence of Microsporidíosis in Domestic Animals and Wildlife

**Maria Lucia Moura**
Nurse, Master. Doctor and Environmental Pathology, Works with Biosafety

## Abstract

Currently, microsporids are phylogenetically characterized as fungi, suffering significant genetic and functional losses resulting in one of the smallest eukaryotic genomes described to date. They do not have mitochondria, and there are around 100 genera and 1,400 species. The objective of this work was to research what has been published regarding the occurrence of microsporidial infection in domestic and wild animals.
**Keywords:** Fungi; Infection; Microsporidia.

## 1. Introduction

Domestic is the animal created and reproduced by man, perpetuating conditions through generations by heredity, offering utilities and rendering services in meekness. About animals, many are opinions about what is or is not domestic [1], states:

*"Domestic animals are those that are under the dominion of man, not individually, but from generation to generation."*

Thus man gives care and food and receives in return utilities and services. The fact of living or even relying on man does not create conditions for the animal to be considered domestic. Created and reproduced by man in captivity and natural meekness for a utility or service, such as cattle, sheep, swine, equines and birds.

Therefore domestic animals are those animals that through traditional and systematized processes of zootechnical management and breeding have become domestic, possessing biological characteristics and behaviors in close dependence on man, and may even present a different appearance of the wild species that originated them.

In this context we have cat, dog, horse, cow, buffalo, pig, chicken, duck, mallard, turkey, ostrich, Chinese quail, cherry partridge, Belgian canary, *Australian parakeet, mandarin, agapornis*, among others [2].

Sanson [3] continues: "Domestic animals are machines, not in the figurative sense of the word, but in the strictest sense of the term, as mechanics and industry admit. They are machines in the same way as the locomotives of our railroads, such as the equipment of our factories, where it is distilled, where sugar, starch is made, where it is weaved, where it is ground, where any matter is transformed , being machines that provide services and products. "

On the other hand, it is necessary to know what the law requires. And for those who wish to enter the commercial or domestic industry, they should seek guidance from a specialized technician or sources Vieira [4] Regarding wild animals, Law 9605/98, known as the new Environmental Crimes Law, in its Article 29, Paragraph 3, defines wild animals with clarity:

> *"Specimens of wild fauna are all those belonging to native, migratory and any other species, aquatic or terrestrial, that have all or part of their life cycle occurring within Brazilian territory or Brazilian jurisdictional waters."* [5].

## 2. Methodology

It was a bibliographic review where productions were selected in the form of articles published in national and international books and periodicals, made available online, articles in full that portrayed the researched topic. We contemplate the following data: journals, books, author (s) and year of publication.

The selection was based on the similarity of subjects to the objective of this study, disregarding those that, although revealed in the search result, did not approach the subject from the point of view of Microsporidiosis in domestic and wild animals.

## 3. Literature Review

As for microsporidia sp are called species due to their ultra-structural characteristics that involve the sizes and morphology of the different stages of development, analyzing how their nucleus is configured and how many spirals exist in their polar tubule [6].

Continuing microsporidia are classified as fungi Peer, *et al.* [7] are opportunistic and the most worrisome, are that they are considered emerging. Infections in fish, insects, and mammals have been described initially and infect various tissues such as muscles, kidneys, eyes and lungs, but the site with the highest rates of infection is in the digestive tract. They are also responsible for the death of a large number of individuals with immune disorders, such as carriers of the HIV virus who already have a weakened immune system [8].

Therefore another very interesting classification is the place where they develop, since some species are restricted to a specific cell of a single organ or system. Others cause systemic infection, involving different organs

and systems, but this has been subject to revision once the molecular analysis has been introduced in the study of these parasites.

In this situation, more than 3000 microsporidium species are described and are divided into 144 genera constituting the phylum Microspora, Deverriere [9] and *Encephalitozoon cuniculi* are commonly described in companion animals, Didier, *et al.* [10]. Mature spores are small, oval measuring approximately *1.5 µm* wide and *2.5 µm* long. The nucleus where the infection material gets penetrates the macrophage releases the tubule and inoculates the cell.

According to Sulaiman, *et al.* [11], microsporidiosis has already been described in small wild mammals, suggesting that these animals may be reservoirs of microsporidia, and may constitute important sources of infection for humans. In Brazil, to date, there is no register of surveys on the infection of small wild animals by microsporidia.

To know there are membrane receptors, *glycosamines glycan*. In the cell there is a vacuole, where the extrusion of the polar tubule perforates the cell. This mechanism is still unknown.

In this form infection in most mammalian hosts with *E. cuniculi* occurs by ingestion or inhalation of contaminated spores from a host. The host cells eventually rupture and release the microorganisms that infect new cells or spore forms resistant to the environment. In dogs and cats infection is localized to the kidneys and liver [12].

## 3.1. Dogs and Cats

In this context the microsporidiosis in dogs and cats is caused mainly by the obligate intracellular parasite *E cuniculi*, which is a member of the phylum of microsporids. Research in Iran on the sequencing of *Polymerase Chain Reaction (PCR)* products confirms these results.

We can conclude that microsporidial infection seems to be quite common in pets in Iran, especially in dogs, and this finding may indicate the importance of pets as zoonotic reservoirs of human infections [13].

On the other hand another research in Galicia in Spain, analyzed 87 samples of feces of domestic animals, like two dogs and a goat by PCR, in order to detect the possible presence of microsporidia in animals where it was concluded and confirmed *Enterocytozoon bieneusi* spores (other microsporidia) in these samples [7].

It is necessary to show that microsporidiosis is a rare infection in dogs and is best known for its deleterious effects on rabbit populations. Infection by microsporidia appears to be acquired by the airways (mouth and nose) when an animal licks or smells of urine with spores of another infected animal.

For this reason, animals that live in kennels are at risk, because they are very close to each other and sometimes with minimal space to move around, and microsporids can survive for long periods in the environment, susceptible to this infection.

## 3.2. Rabbits

Following continuity four fecal samples of rabbits reacted with *E. cuniculi* antiserum, and the results may indicate the importance of domestic animals as zoonotic reservoirs of microsporidia infecting man and *E cuniculi* is probably the most common in these infections [14].

These microsporidos are known to infect domestic animals such as *Enterocytozoon bieneusi, Encephalitozoon intestinalis, Encephalitozoon cuniculli, and Encephalitozoon Hellen*, Wagnerova, *et al.* [15], microsporids are quite common in sea water, freshwater and estuaries constituting a constant threat to aquaculture, Rodriguez, *et al.* [16]. More than 158 species of microsporidia in 7 genera have been documented for infecting fish [17].

Continuing *E cuniculli* is a parasite that causes severe central nervous and kidney infection in pet rabbits (*Oryctolagus cuniculus*). It is a significant disease of rabbits in captivity and their prevalence serum is recognized internationally, mainly in laboratory rabbits [18].

It is worth emphasizing that *E. cuniculi* infection has been considered a pathogenic and opportunistic zoonosis since it also affects immunocompromised humans [12]. Microsporidium *E.cuniculi* is the most extensively studied microsporidium and spontaneous this parasite were documented in rabbits, rats, rats, and musk rats.

There were also reports on hamsters, guinea pigs, goats, sheep, pigs, horses, domestic dogs, wild and captive foxes, domestic cats, and a variety of exotic carnivores, and on non-human primates where three strains of *E cuniculli* were identified genetically Didier [19] and Ozkan, *et al.* [20].

In this context, although less well documented, *E. cuniculi* has been confused with the agent of rabies and with implications for diseases such as *Typhus, Psittacosis, Leukemia*, experimental allergic encephalomyelitis, and chemical Carcinogenesis [21].

## 3.3. Birds

According to Magalhães, *et al.* [22] a study was carried out with 132 animals among domestic pigeons, exotic birds and dogs, and 17 cases were found positive for microsporidia. The species of birds in which *E hellen* was identified, no bibliographic reference was found mentioning the birds as hosts of *E. hellen*. However the above-mentioned author stated that a work already done in Australia suggested that the Japanese finch could be host to *E. hellen* [23].

As already mentioned, some authors support the hypothesis that birds are the reservoirs of *E. hellem* and humans are only accidental hosts developing the disease, only under conditions of immunodepression. But how can *E. hellen* be transmitted from birds to humans?

Continuing studies with 51 samples of fresh feces in South Korea collected from parrots reared in captivity and kept in private homes, where all birds surveyed appeared healthy at the time of sampling. Samples were collected by

placing sheets of paper under the bird cages. Fresh bird droppings were placed in sterile tubes and immediately frozen at -70 ° C until analysis. Pathogenic human microspore genotypes were detected and identified [24].

In this context microsporids were identified in eight samples 15.7% seven parrots were positive for *E hellen*, and one parrot tested positive for both E. hellen and *E cuniculi.* In genotypic identifications, *E. hellen* was present in genotypes 1A and 2B and *E cuniculli* was present in genotype II. Pet parrots may be a source of human microsporidial infection [24].

On the other hand, a researcher in England has drawn a possible way of transmitting spores of microsporids, from birds to humans, that is, in birds microsporid infections are frequently located in the intestine and kidneys, with the spores being eliminated (1999), and because the water content of poultry waste is very low, they dry up rapidly, causing the formation of organic dusts containing viable spores, which can trigger infection in humans, particularly if they are immunocompromised.

It should be noted that the microsporidia that are pathogenic to man measure between 1 and 3 mm and can therefore be transported by the so-called inhalable dust (<5 mm), that is, they can reach the pulmonary alveolus. This mode of transmission is described for other pathogens such as *Histoplasma capsulatum* and *Chlamydophila psittaci* [22].

According to Black, *et al.* [25] there was an infection in Australian parakeets (*Melopsittacus undulatus*) where *E. hellen* parasite infected the intestine with neonatal mortality rates ranging from 14 to 75%. There are only two reports of ocular infection by *E. hellen* described in birds in a yellow-browed parrot *O. oratrix* Canny, *et al.* [26] and another in *Cacatua alba* [27].

In fact the first report of infection in Australian parakeets *Melopsittacus undulatus* was made by Black, *et al.* [25], where the parasite was found to infect the intestine and neonatal mortality rates ranged from 14 to 75%. There were also infections in parakeets *Agapornis spp*. with the agent infecting the intestinal and renal tissues with a positive rate of 25%, but the birds were asymptomatic [28].

Continuing this microorganism was also detected with cloacal swab striatal larynx in *Chalcopsitta scintillata* and also a case of pulmonary and systemic disease in a yellow-browed Amazon parrot *ochrocephala oratrix.* [29].

### 3.4. Reptiles

According to Karri [30] the native snake species from Australia known as Death Adder is one of the most venomous terrestrial snakes in the world. This snake is under threat due to the destruction of its habitat. Cryptosporidiosis spp was found within lesions in the snake muscles.

It was also identified Cryptosporidiosis in native lizards deserts of northern and central Australia button-tail gecko. They are bred in captivity and have a large tail with a small button at the end, and large round eyes. Cryptosporidiosis has also been identified in lizards. These microorganisms were also identified within granuloma in the ovary of an eastern water dragon [30].

### 3.5. Fish

In the Bangkok region (Thailand) four infected specimens of *Pangasius sutchi* known as (hammerhead shark) collected in a fish farm were examined with suspected microsporidia. In two the infection was apparent with white patches visible through the skin [31].

Following the main histological changes induced by other microsporidia *Kabatana arthuri*, says Lom, *et al.* [31] was in the catfish shark, in the lateral musculature or in the dorsal muscle. Microsporidium *K. arthuri*, Lom, *et al.* [31] induced severe regressive changes in P. sutchi trunk muscles in Thailand. Necrotic changes were also observed in muscle fibers. An inflammatory reaction was observed only in exceptional cases.

Spore-laden macrophages have been found in various tissues and organs and their infiltration into the epidermis, including the outermost layers help the spread of the infection while the hosts are still alive [32].

### 3.6. Monkeys

Disseminated natural infections resulting in high morbidity and severe encephalitis, caused by Encephalitozoon-like organisms, have been reported in stillborn monkeys (*Saimiri sciureus*) and young adults in the United States. Although the identification of the parasite was based only on electron microscopy, which does not distinguish *E. cuniculi* from E. Hellen, neuropathological symptoms strongly suggested that *E. cuniculi* was the species involved [33].

## 4. Result and Discussion of Data

A total of 33 studies were identified, including books, electronic journals and printed matter available in full and on line. In the year 1907, 1971, and 1985, we found only one publication. In the years of 1990, 1998, 2008, 2009, 2010, 2006 and 2012, we found two studies. In the years 1999, 2003, 2005, three published works were found. The microsporidium most involved in infections was *E cuniculli.*

The year in which there were major publications was in 2011 with four studies. It was decided to highlight the periodicals, authors and year of publication, according to the table 1**.**

**Table-1.** Articles taken from Books and Magazines

| Magazines and Books | Author (es) | Year of Publication |
|---|---|---|
| Traité de Zootechnie.Tome I | Sanson,A | 1907 |
| J Americano Pathology | Shadduck JA,Pakes SP | 1971 |
| Vet Pathol | Zeman DH, Baskin GB | 1985 |
| Folia Parasitol (Praha) | Lom J. Dyková F. | 1990 |
| Brasil | Ministerio da Saúde | 1998 |
| Tratado de Infectologia | Veronesi Ricardo | 1997 |
| Rev. Vet Pathol | Focaccia Roberto Black SS, Steinohrt LA, Bertucci DC et al | 1997 |
| Journal of Avian Med Sugery | Canny CJ,Ward DA, Patton S. et al | 1999 |
| J Europe Pubmed | Curry A | 1999 |
| Journal of Infectious Diseases | Snowden K, Logan K, Didier ES | 1999 |
| Folia Parasito | Dykova I, Lom J | 2000 |
| Journal on Genes, Genomes and Evolution. | Peer VY, Ali BA, Meyer A | 2000 |
| Rev.Memórias do Instituto Oswaldo cruz | Arias C,Aguila Del C Lores B | 2002 |
| Journal Australian Vet | Carlisle MS, Snowden K, Gill J, Jones M, O'donoghue P, Prociv P | 2002 |
| Ecole Nationale Veterinaire de Toulouse. | Deverriere, MMA | 2003 |
| J. Avian Med. Surg | Barton Casey E, Phalen David N, Snowden Karen F | 2003 |
| Rev Parasitology Vet | Sulaiman Im, Fayer R, Lal AA Truta MJ, Schaefer WF, Xiao L | 2003 |
| Rev Acta Tropica | Didier ES | 2005 |
| The Australian Registry of Wildlife Health | Karri, R. | 2005 |
| Microbiologia Clinica | Mathis A, Weber R, Deplazes, P | 2005 |
| Rev. Portuguesa Ciências Veterinárias | Magalhães N, Lobo LM, Antunes F Matos O. | 2006 |
| Rev. Vet. Ophthalmol | Phalen, DN, Logan, KS, Snowden, KF | 2006 |
| Rev Parasitology | Casal G, Matos E, Teles-Grilo ML, Azevedo C | 2008 |
| Vet Parasitol | Didier ES, Stovall ME, Green LC et al. | 2004 |
| Persistencia | Vieira FJ. | 2009 |
| Rev Vet Parasitology | Hauptman K, Koudela B, Neu MRH, Jeklova E, Jeki V, Kovarcik K, Knotek Z, Faldyna M | 2010 |
| Revista UNILUS Ensino e Pesquisa | Gotti MSL, Gagliani HL. | 2011 |
| Rev Vet Parasitology | Rev Vet Parasitology Ozkan O, Ozkan AT, Zafer K. | 2011 |
| Rev Fish and Shelfish Imunology | Rodriguez TLE, Speare DJ, Frederick MRJ | 2011 |
| American Society for Microbiology | So-Young L, Sung-Seok L, Jovem SL, Hee-Myung P | 2011 |
| Rev Vet Parasitology | Jamshidi SH, Tabrizi AS, Bahrami M, Momtaz H | 2012 |
| Rev Labor Real | Baudment E | 2012 |
| Rev Parasitology Vet | Wagnerova P, Sak B, Kvetonova D, Marselek M, Langrova I, Kvac M | 2013 |
| Rev Suipa | Soc. União Protetora dos Animais | 2015 |

## *4.1. Final Considerations*

Microsporids are primitive eukaryotes that persist probably due to lack of basic sanitation and sanitation. Oocysts are known to resist chlorine, and there is also the danger of eating raw meats. Microsporids were found in the 1980s in HIV-infected individuals. It currently causes infection in a variety of invertebrates and vertebrates. Nowadays, many cases of microsporidiosis have been identified, including infecting a wide variety of animals including domestic animals, and causing diarrheal disease in HIV / AIDS patients. Publications on microsporidia in domestic and wild animals are still incipient.

## References


[1] Baudement, E., 2012. "Les Mérinos, Précédé de considérations générales surl'espèce ovine par le Comte Guy de Charnacé. Librairie d'éducation et d'agriculture. Paris, Edi teur Delagrave et Cie. Rev. Labor Real Disponível em." vol. 1, pp. 124-128. Available: http://laboreal.up.pt/files/articles/124_128.pdf

[2] SUIPA, 2015. "Sociedade união internacional protetora dos animais." Available: http://www.suipa.org.br/index.asp?pg=duvidas_detalhes.asp&pg2=4&id=30

[3] Sanson, A., 1907. *Traité de Zootechnie, Tome I*. 5th ed. Paris: Librairie agricole de la Maison Rustique.

[4] Vieira, F. J., 2009. "Persistência, Edt, Clube de autores, Rio de Janeiro."

[5] Brasil, 1998. "Presidência da república casa civil subchefia para assuntos jurídicos, Lei nº 9.605, de 12 de Fevereiro de Disponível em." Available: http://www.planalto.gov.br/ccivil_03/leis/l9605.htm

[6] Gotti, M. S. L., Gagliani, H. L., and Microsporidiose, H., 2011. "Aspectos epidemiológicos e diagnósticos nos pacientes com AIDS." *Revista UNILUS Ensino e Pesquisa São Paulo*, vol. 8, Available: www.revista.unilus.edu.br/index.php/ruep/article/download/53/u2011v8n14e53

[7] Peer, V. Y., Ali, B. A., and Meyer, A., 2000. "Microsporidia, Accumulating molecular evidence that a group of amitochondriate and suspectedly primitive eukaryotes are just curious fungi." *International Journal on Genes, Genomes and Evolution*, pp. 1-8. Available: https://www.sciencedirect.com/science/article/pii/S0378111900000639?via%3Dihub

[8] Veronesi, 1997. "Ricardo, FOCACCIA, Roberto, Tratado de Infectologia, São Paulo, Atheneu." pp. 1170-1174.

[9] Deverriere, M. M. A., 2003. "Microsporidies Communes a L'homme et anima ux, etude bibliographique Disponivel em." *Ecole Nationale Veterinaire de Toulouse*, vol. 3, p. 4056. Available: http://oatao.univ-toulouse.fr/999/1/debouch_999.pdf

[10] Didier, E. S., Stovall, M. E., and Green, L. C., 2004. "Epidemiology of microsporidiosis: sources and modes of transmission." *Vet Parasitol*, vol. 126, pp. 145-166. Available: https://www.ncbi.nlm.nih.gov/pubmed/15567583

[11] Sulaiman, I. M., Fayer, R., Lal, A. A., Truta, M. J., Schaefer, W. F., and Xiao, L., 2003. "Molecular characterization of microsporidia indicates that wild mammals harbor host-adapted Enterocytozoon spp, as well as human-pathogenic." *Enterocytozoon Bieneusi. Appl. Environ. Microbiol.*, vol. 69, pp. 4495-4501. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC169096

[12] Mathis, A., Weber, R., and Deplazes, P., 2005. "Zoonotic potential of the microsporidia." *Clin. Microbiol. Rev.*, vol. 18, p. 423. Available: http://cmr.asm.org/content/18/3/423.full.pdf+html

[13] Jamshidi, S. H., Tabrizi, A. S., Bahrami, M., and Momtaz, H., 2012. "Microsporidia in household dogs and cats in Iran, A zoonotic concern." *Rev. Vet. Parasitol.*, vol. 185, pp. 121-123. Available: http://www.ncbi.nlm.nih.gov/pubmed/22035849

[14] Arias, C., Aguila, D. C., and Lores, B., 2002. "Enterocytozoon bieneusi (Microspori dia) in faecal samples from domestic animals from Galicia." *Spain Rev. Memórias do Instituto Oswaldo Cruz Disponível em*, vol. 97, pp. 941-945. Available: http://memorias-old.ioc.fiocruz.br/977/4517.html

[15] Wagnerova, P., Sak, B., Kvetonova, D., Marsalek, M., Langrova, I., and Kvac, M., 2013. "Humoral immune response and spreading of Encephalitozoon cuni culi infection in experimentally infected ponies." *Rev. Veterinary Parasitology*, Available: http://journals.ohiolink.edu/ejc/article.cgi?issn=03044017&issue=v197i1-2&article=1_hirasociieip

[16] Rodriguez, T. L. E., Speare, D. J., and Frederick, M. R. J., 2011. "Fish micros poridia immune response, immuno modulation and vaccination." *Rev. Fish and Shellfish Immunology,*, vol. 30, pp. 999-1006. Available: http://www.ncbi.nlm.nih.gov/pubmed/21352922

[17] CASAL, G., MATOS, E. M., TELES-GRILO, M. L., and AZEVEDO, C., 2008. "A new microsporidian parasite, Potaspora morhaphis n. gen., n. sp. (Microsporidia) infecting the Teleostean fish, Potamorhaphis guianensis from the River Amazon. Morphological, ultrastructural and molecular Characterization, 2008." Available: https://www.researchgate.net/publication/23163190A_new_microsporidian_parasite_Potaspora_morhaphis_n_gen_n_sp_Microsporidia_infecting_the_Teleostean_fish_Potamorhaphis_guianensis_from_the_River_Amazon_Morphological_ultrastructural_and_molecular_Char

[18] Jeklova, E., Jeki, V., Kovarcik, K., Hauptman, K., Koudela, B., Neu Maye, R. H., Knotek, Z., and Faldyna, M., 2010. "Usefulness of detection of specific IgM and IgG antibodies for diagnosis of clinical encephalitozoonosis in pet rabbits." *Rev. Veterinary Parasitology*, vol. 170, pp. 143-148. Available: http://www.ncbi.nlm.nih.gov/pubmed/20153117

[19] Didier, E. S., 2005. "Microsporidiosis an emerging and opportunistic infection in hu mans and animals Disponível em." *Rev. Acta. Tropica*, vol. 94, pp. 61-76. Available: http://www.ncbi.nlm.nih.gov/pubmed/15777637

[20] Ozkan, O., Ozkan, A. T., and Zafer, K., 2011. "Encephalitozoonosis in New Zealand ra bbits and potential of transmission risk." *Rev. Veterinary Parasitology*, vol. 179, pp. 234-237. Available: http://europepmc.org/abstract/MED/21377801

[21] Shadduck, J. A. and Pakes, S. P., 1971. "Encephalitozoonosis (nosematosis) and toxoplasmosis." *Am. J. Pathol.*, vol. 64, pp. 657-671. Available: http://www.ncbi.nlm.nih.govgov/pmc/articles/PMC2047627/

[22] Magalhães, N., Lobo, L. M., Antunes, F., and Matos, O., 2006. "Aves e cães como potencial fonte de infecção zoonótica por microsporídeos para o Homem." *Rev. Portuguesa Ciências Veterinárias, Lisboa, Portugal,* pp. 69-75. Available: http://www.fmv.utl.pt/spcv/PDF/pdf6_2006/557_558_69_75.pdf

[23] Carlisle, M. S., Snowden, K., Gill, J., Jones, M., O'donoghue, P., and Prociv, P., 2002. "Microsporidiosis in a gouldian finch (Erythrura [Chloebia] gouldiae) Disponível em." *Australian Veterinary Journal,* vol. 80, pp. 41-44. Available: http://onlinelibrary.wiley.com/doi/10.1111/j.1751-0813.2002.tb12044.x/abstract

[24] So-Young, L., Sung-Seok, L., Jovem, S. L., and Hee-Myung, P., 2011. "Detecção de DNA e genotípica identificação de potencial humano-pathogenic microsporidia de as sintomáticos Pet Papagaios na Coréia do Sul como fator de risco para Zoonotic Emergence. American Society for Microbiology, Applied and Environmental Microbiology." Available: http://aem.asm.org/content/77/23/8442.full

[25] Black, S. S., Steinohrt, L. A., and Bertucci, D. C., 1997. "Encephalitozoon hellem in budgerigars (Melopsittacus undulates) Disponível em." *Rev. Vet. Pathol.,* vol. 34, pp. 189-198. Available: http://vet.sagepub.com/content/34/3/189.short

[26] Canny, C. J., Ward, D. A., and Patton, S., 1999. "Microsporidian kerato conjuncti vitis in a double yellow headed Amazon parrot (Amazona ochrocephala oratrix) Disponível em." *J. Avian Med. Surg.,* vol. 13, pp. 279-286. Available: http://onlinelibrary.wiley.com/doi/10.1111/j.1463-5224.2005.00434.x/abstract?deniedaccesscustomisedmessage=&userIsAuthenticated=false

[27] Phalen, D. N., Logan, K. S., and Snowden, K. F., 2006. "Encephalitozoon hellem as the cause of a unilateral chronic keratoconjunctivitis in a umbrella cockatoo." *Rev. Vet. Ophthalmol,* vol. 9, pp. 59-63. Available: http://onlinelibrary.wiley.com/doi/10.1111/j.14635224.2005.00434.x/abstract?deniedAccessCustomisedMessage=&userIsAuthenticated=false

[28] Barton, C. E., Phalen, D. N., and Snowden, K. F., 2003. "Prevalence of Microsporidian spores shed by asymptomatic lovebirds, evidence for a potential emerging zoonosis." *J. Avian. Med. Surg.,* vol. 17, pp. 197-202. Available: http://www.bioone.org/doi/abs/10.1647/2002-011

[29] Snowden, K. F. and Phalen, D. N., 2004. "Encephalitozoon infecção em aves." *Journal of Medicine Exotic Pet.,* vol. 13, pp. 94-99.

[30] Karri, R., 2005. "Common diseases of urban Wildlife, REPTILES, The Australian registry of wildlife health." Available: http://www.arwh.org/sites/default/files/files-uploads/Common%20Diseases%20of%20Reptiles_with_images.pdf

[31] Lom, J., Dyková, I., and Shaharom, F., 1990. "Microsporidium arthuri n. Sp. parasite of Pangasius sutchi in South-East Asia." *Dis. Aquat. Org.,* vol. 8, pp. 65-67. Available: http://www.int-res.com/articles/dao/8/d008p065.pdf

[32] Dykova, I. and Lom, J., 2000. "Histopatologia da Kabatana arthuri (Microspora) infecção em sutchi catfish, Panagasius sutchi Disponível em." *Folia Parasitol (Praha),* vol. 47, pp. 161-166. Available: http://www.ncbi.nlm.nih.gov/pubmed/11104142

[33] Zeman, D. H. and Baskin, G. B., 1985. "Encephalitozoonosis in squirrel monkeys (Saimiri sciureus)." *Vet. Pathol.,* vol. 22, pp. 24-31. Available: http://journals.sagepub.com/doi/10.1177/03009858850220010