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STUDY OF GASTROINTESTINAL NEMATODOSIS
IN PIGS IN MUREȘ COUNTY

SUMMARY OF PhD THESIS

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I. PART I - ETIOLOGY, PATHOGENESIS, DIAGNOSIS, TREATMENT AND PREVENTION ASPECTS OF SWINE DIGESTIVE HELMINTHOSIS

We note that in past decades have not done systematic research on helminthosis in pigs in northwest areas where the growth of this species is predominant. Bazna pig race is known and widely used in households in Mures County.

For these reasons and to deepen knowledge of the epidemiology, therapeutic and preventive means, we conducted research on digestive nematodozelor.

I.1. NEMATHODOSIS

Of these helminthosis, the most frequently reported are ascariosis, trichocefalosis, trichnosis, strongiloidosis, oesophagostomosis and others.

I.1.1. Ascariasis

Is a nematodosis mainly affecting young pigs, caused by Ascaris suum, the fam. Ascaridae, which show adult stage in the small intestine, usually causing digestive, respiratory, nervous and general disorders. Meets more frequently in communities of malnourished animals, unsanitary housing conditions.

Etiology
Systematic: parasites are employed Nemathelminthes phylum, class Nematoda, Secernentea subclass, order Ascaridida, Ascarididae family, genus Ascaris, Ascaris suum species, which affects pigs, sheep accidentally.

Biological cycle: monoxenous, is carried on by alternating phases with exogenous parasite. Adults develop in the small intestine, especially in the duodenum and chyme feeds.
I.1.2. Oesophagostomosis

It is an intestinal helminthosis affecting pigs, and other species of ruminants, caused by nematodes of the genus *Oesophagostomum*, manifested by severe digestive disorders, weight loss and reduced body growth in young animals. The disease is found throughout the world, evolving enzootic in young pigs.

**Etiology**

*Systematic*: parasites belonging to the phylum *Nemathelminthes*, class *Nematoda*, order *Strongylida*, *Strongyloidae* family, genus *Oesophagostomum*. In pigs, parasites: *Oesophagostomum dentatum*, adult worm is located in the caecum and colon of pigs and boars, and the larvae (L₄ and L₅) in small and gross intestine submucosa; *O. quadrispinulatum*, widespread; *O. brevicaudum* in south-eastern United States and elsewhere with similar climate and *O. granatensis* and *O. georgianum* in Europe, respectively southeastern U.S., species considered morphological variants of *O. dentatum* (Raynaud et al., 1974; Stewart and Gasbarre, 1989; Cutillas et al., 1999)

*Biological cycle*: monoxenous, strongyl type, runs going through the same stages in all species. Eggs reach the external environment with the mass of faeces, and larvae hatch exogenous occurs successively, then the two sheddings, forming infested larvae (L₃). Animals contamination is by mouth.

I.1.3. Globocephalosis

It is an helminthosis especially affecting wild boar and sporadically domestic swine. Is manifested by respiratory, digestive and sometimes skin disorders. The disease is spread worldwide, but only in some areas cause damage by morbidity and mortality in pigs. Our country currently shows no increased veterinary interest.

**Etiology**

*Systematic*: etiologic agent is *Globocephalus urosubulatus*, called incorrectly *Globocephalus longemucronatus.*(Hartwich, 1986) Belonging to the genus *Globocephalus*, family *Ancylostomidae*, *Strongyloida* order, class *Nematoda*. 
Biological cycle: occurs directly. Adults parasites intestine, mainly in wild boars, less domestic swine. They are hematophagous, the female is oviparous and the eggs removed with the feces outdoors evolves to stage L₃ larvae infested. Pigs contamination is made orally, eating food and water with L₃ larvae.

I.1.4. Hiostrongiloza

Evolves sometimes as a subclinical benign gastritis, sometimes with digestive and general metabolism disorders in piglets and young pigs produced by *Hyostrongylus rubidus*. Lately is detected in several countries.

Etiology

**Systematic:** *Hyostrongylus rubidus*, *Hyostrongylus* genus, part of the *Trichostrongylidae* family, *Strongylida* order, class *Nematoda*.

**Biological cycle:** is done directly, like that of other *Trichostrongylidae*. Adults live on the surface and glands of the pig gastric mucosa.

I.1.5. Strongyloidosis

Is an helminthozoonosis determined by *Strongyloides ransomi*, clinically manifested by skin, respiratory and digestive disorders, affecting young animals, food and hygienic poorly maintained. Is spread throughout the world, with uneven distribution, depending on the type and level of social life and the development of animal husbandry. Incidence in humans is higher in tropical areas, but in animals is often meets in temperate climatic conditions.

Etiology

**Systematic:** etiologic agent is *Strongyloides ransomi*, *Strongyloididae* family, *Rhabditida* order, steno-specific parasitism being adapted, or more host species. Only females and larval forms go parthenogenetic parasitic life. They develop in the small intestine mucosa and submucosa, and larvae in various tissues.

**Biological cycle,** is characterized by multistage development. Of eggs deposited by parthenogenetic females, rhabditoid larvae hatched either during intestinal transit or after manure removal on soil.
Exogenous stages evolve in two ways, directly or indirectly conditioned by ambient thermal regime, but also intrinsic factors.

**I.1.6. Trichocephalosis**

Is one chronic geohelminthosis that affects pigs, frequently evolving subclinical, caused by nematodes with location in the colon and caecum.

**Etiology**

*Systematic*: etiologic agent is *Trichocephalus suis*, *Trichocephalus* genus, *Trichocephalidae* (*Trichuridae*) family, *Trichurida* order, class *Nematoda*.

*Biological cycle*: adult worms are fixed with the anterior end in the depth of caecum and colon submucosa, blood feeding. Eggs come with faeces on soil and moisture, oxygen and heat, induce the larval evolution, which remain inside the egg. Under favorable conditions, with 28 - 32°C, relative humidity of 100%, airy and shady soils, embryonic egg occurs about 10 days. (Rubin, 1954; Beer, 1973b; Nitzulescu and Gherman, 1986). Contamination with infested eggs occurs with food or water, during ingestion.

**I.1.7. Gastric spiruridosis**

Is a bio-helminthosis including more etiological entities, with chronic evolution, sometimes subclinical, affecting the pigs, manifested by digestive and general disorders, determined by spirurids species.

The disease occurs in pigs reared in the household system. Incidence is low in our country.

**Etiology**

*Systematic*: etiologic agents are part of the *Spirocercidae*, *Thelaziidae* and *Gnathostomatidae* family, included in *Spirurida* order, class *Nematoda*.

In the first family are *Ascarops*, *Physcepalus* genera; *Simmondsia* genus is included in *Thelaziidae* family, and, in the last family is included *Gnathostoma* genus.
Biological cycle: di-heteroxenous, is achieved by intermediate hosts, coprophagous beetles. Adults remove embryonated eggs that reach the ground and water by faeces. Further, eggs are ingested by intermediate hosts from the genera: *Aphodius*, *Ontophagus*, *Geotrupes*, *Scarabeus*. In their body, hatch larvae, which become infected after two sheddings (L₃).

### I.1.8. Gongylonemosis

Gongylonemosis, train as a state of usually asymptomatic parasitism, affecting the esophagus and other digestive ducts prior to herbivores, pigs and birds, caused by nematodes of the genus *Gongylonema*. Disease is diagnosed after death or killing animals.

**Etiology**

**Systematic:** parasites in pigs *Gongylonema pulchrum* and *Gongylonema mucronatum* (Quentin și Seguignes, 1979), *Gongylonematidae* family, *Spirurida* order, class *Nematoda*.

**Biological cycle:** di-heteroxenous, require intermediate host ontogenetic development. Adult parasites esophageal mucosa and submucosa in pigs, but have also lingual location (Zinter și Migaki, 1970); females remove eggs by the esophageal mucosal holes and trained with feces, reaching the ground, grass, where ingested by intermediate hosts - coprophagous coleoptera from *Aphodius*, *Ontophagus* and tenebrionidae (*Blatella*) genera.( Fincher și col., 1969) Larvae hatch in their body and become infected after two sheddings (L₃). Definitive hosts contamination is through consumption of infected beetles containing encapsulated larvae, with grass.

### I.2. OTHER HELMINTHOSIS

#### I.2.1. Fasciolosis

Is a hepatic biliary disease, enzootic, seasonal, affects herbivorous animals, especially ruminants, but omnivorous, the pig is the species most affected in this category, evolving chronic, rarely acute, caused by species of the genus *Fasciola*. 

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Etiology

Systematic: in our country, the disease is produced by *Fasciola hepatica*, *Plathelminthes* phylum, class *Trematoda*, *Echinostomatida* order, *Fasciolidae* family, *Fasciola* genus.

**Biological cycle:** di-heteroxenous, definitive hosts are pigs, and intermediate hosts are aquatic snails: *Galba truncatula*, main host, *Limnea stragnalis*, *L. pallustris*, *Radix sp.*

Young parasites are present in the liver parenchyma and the adult in bile ducts; sometimes in massive infestations, were in heart, lung, peritoneal cavity. They are hematophagous.

### I.2.2. Swine cestodosis

Are diseases caused by parasitic *Cestoda* class, which in the adult stage develops in the gastrointestinal tract and their larvae in different organs and tissue from mammals, fish or arthropod, causing metacestodosis.

In pig evolving diphyllobothriasis and thysaniesiasis.

**Etiology**

**Systematic:** etiologic agents are:

- *Diphyllobothrium latum* - *Diphyllobothriidae* family, *Pseudophyllidea* order.
- *Thysaniezia giardi* - *Anoplocephalidae* family, *Cyclophyllidea* order.

**Biological cycle:**

*Diphyllobothrium latum*: tri-heteroxenous, multistage. Adult develop in small intestine of pigs and other ichtyophagous mammalian; they remove eggs by faeces. Eggs evolving in warm aquatic biotopes. Animals contamination is by consuming fish with plerocercoides larvae.

*Thysaniezia giardi*: di-heteroxenous, is accomplished with the participation of intermediate hosts, grass mites consist of the families: *Scheloribatidae*, *Galumnidae*, *Liacaridae*. Pigs contamination occurs on pastures through ingestion of mites intermediate hosts, with grass.
I.2.3. Trichinosis

Cosmopolitan zoonosis, with severe clinical manifestations in human and asymptomatic in omnivorous animals, rodents and carnivores, trichinellosis has focal features, caused by *Trichinella* nematodes with adult intestinal stage development and muscle in the larval, in the same host body. Not a intestinal hemintosis, trichinosis is characterized by the existence, in the biology of parasites of a major intestinal phase, which is the reason why insist on those digestive steps of disease.

Etiology

*Systematic*: *Trichinella* species are included in *Nemathelminthes* phylum, *Nematoda* class, *Enoplida* order, *Trichinellidae* family, *Trichinella* genus, currently there are eight species and three genotypes with uncertain status.

*Biological cycle*: development type of parasites is auto-heteroxenous.

I.2.4. Acanthocephalosis

Intestinal bio-helmithosis, spread almost all over the globe, produced by *Macracanthorhyncus hirudinaceus*, affects pigs, rarely other mammals, evolved asymptomatic or chronic with digestive disorders.

Etiology


*Biological cycle*: adult worms are fixed with the cephalic trunk in intestinal mucosa, sometimes penetrating to the pig intestine serous, affecting also cattle, sheep and dog. Ontogenetic development depend by the existence of intermediate hosts *Melolontha melolontha* and *Cetonia aurata*. Pig contamination is by ingestion coleopteran in any developmental stages containing infested larvae (cystacant).
II. PART II - PERSONAL RESEARCH

II.1. AIM

We can structure the objectives of the thesis in general objectives and specific targets. In what follows, we elaborate the general objectives, specific ones being presented to those chapters.

First objective was to determine the epidemiological characteristics of helminthosis in pigs in different husbandry systems in Mureș county, linked to technological category, the interrelationships with age and physiological status of animals.

The second major objective was the fundamental research and consisted in clarifying some aspects of histopathology in the infestation by nematodes in pigs. They had two developmental disorders models: *Ascaris suum* infestation, eating intestinal chyme, with localization in the pig small intestine and free location; *Trichinella spiralis* infestation, nematode with auto-heteroxenous biological cycle, with an intestinal phase in which adult parasites made sexual multiplication, and a muscle phase that is the purpose of the biological cycle of the parasite in the parasitic host.

Next pursued theoretical side approached applied scientific research, and therapeutic efficacy study consisted of two antiparasitic molecules: flubendazole and doramectin in the natural helminths infestation of swine.

An ultimate goal, a fundamental biological nature, aimed to clarifying the structure of wild boar helminthofauna, *Sus scrofa* L., in Mureș county.

To summarize the above the thesis brings its original contributions on their stated objectives, to clarify the predominant histological picture in the digestive helminths infestation of the pig or in determining the helminths fauna in wild boar from Mureș county.

II.2. DIAGNOSTIC METHOD USED

Faecal samples collected during the course of experiments were processed by usual coproparasitological methods, qualitatively
and quantitative, used in the coproparasitologic diagnosis namely Willis method for highlighting of light parasitic elements (nematode eggs, coccidia oocysts), centrifugal sedimentation method for identification of heavy parasite elements (eggs of trematodes) and MacMaster method, quantitative method.

Were made also Baermann method for larvae, trichinoscopic examination and artificial gastric digestion.(Cozma și col., 2001)

II.3. LOCATION OF STUDY

II.3.1. Geo-climate characteristics of Mureș County

Mureș County is located in central-northern Romania, in the center of Transylvania. Physico-geographical axis is given by the Mureș River County, who travels from NE to SW over a distance of 140 km, lending her name. Landscape, hilly and plateau, is currently at a rate of 50 from the county. Mures county territory has a rich network of rivers, lakes, ponds, retention ponds and artificial basins. Mureș County is in the continental climate sector where appears moderate hill and mountain type. (Şoneriu și Mac, 1973; Lupu și col., 1980)

II.3.2. Demographic and occupational characterization of Mures county

On March 18, 2002, according to census results, Mureș county population was 580,851 inhabitants. Concerning the population structure by sex, as in the previous census in 2002, remains a slight numerical dominance of female population. Rural settlements in Mures county, numbering 487 (1973), are confirmed in the vast majority in the Middle Ages (XI-XVIII century). In these rural areas are rearing pigs in the traditional system, with access to pasture, where animals find food resources required, bringing man and a reduced contribution to their food ration daily. This farming system, associated with climatic conditions, harsh winters, with temperatures down to-30°C and dry summers, when the temperature climbs to 40°C influence the evolution and spread of helminthosis in
pigs, especially geohelminthosis: ascariasis, trichocephalosis, strongyloidosis and metacestodosis. Some parasitic elements: eggs, larvae, oocysts, are destroyed in the winter and excessively hot and dry summers.

II.4. RESEARCH ON THE GASTROINTESTINAL PIGS NEMATODOSIS EPIDEMIOLOGY IN MUREŞ COUNTY

II.4.1. Aims

Determination of epidemiological aspects of infestation with helminths in pigs in breeding herds from different systems: prevalence, intensity of parasitism, and multi-seasonal dynamics, within the age groups and physiological status.

II.4.2. Material and methods

Research has been conducted between 2003 - 2005 on 5500 swines, different races and ages from three growing systems, namely:

- Pigs from household farming system – 100 animals from households (GP) in the area Moşuni, Miercurea Nirajului locality, Mureş;
- Pigs reared in semi-intensive system– 400 pigs kept in the agro-livestock farm (GAS) Prison Mures;
- Pigs kept in intensive system (SI) – 5000 animals originating from the SC PIG srl Band, Mureş;

Each year were made four faeces sampling, overlapped those four seasons. In each stage 300 samples were collected, namely:

- First collection - January, winter collection;
- Second sampling - April, spring sampling;
- Third sampling– July, summer sampling;
- Fourth sampling – October, autumn sampling;

Ages and physiological status of the animals were: breeding sows, breeding boars, piglets weaned between 6-7 weeks of age and 13-15 kg body weight, fattening youth, aged about three months and weight between 30-40 kg body.
II.4.3. Results

Of the 3600 samples collected from the three growth systems and processed by the above methods, the seasons of winter, spring, summer and autumn, in the three years studied, had a number of nematode infestations with 474 samples revealing an overall prevalence of these diseases by 13.1%.

Breeding sows, had infestations with *Trichocephalus suis* and *Strongyloides ransomi*.

Infestation with *T. suis* was diagnosed mainly in pigs reared in household, with an incidence ranging between 20-60% during the three years, with a maximum of 60% in determining the winter of 2004. In semi-intensive growth, *T. suis* showed an incidence of 20% being diagnosed in five out of 12 determinations made.

*S. ransomi* infestation was detected in a single determination made in the spring of 2003 at a pig originating in household.

In boars, the infestation with *T. suis* was detected, with incidence ranging from 20-40% on household, semi-intensive system has evolved from a single animal (20%).

In weaned piglets were diagnosed infestations with: *Ascaris suum* (76,05%), *Strongyloides stercoralis* (13,02%) and *Oesophagostomum dentatum* (10,92%).

*A. suum* infestation was diagnosed in all farming systems: in the household ranged between 10-40%, in semi-intensive growth between 4 and 20%, and intensive system recorded the lowest level, between 4 - 16%.

*S. ransomi* infestation was diagnosed in large farms system recording values of incidence between 4-20%. In semi-intensive growth was diagnosed in one control, representing 4%.

Infestation with *O. dentatum* was diagnosed in household system, with an incidence varying between 4-16%. In semi-intensive system was highlighted in a single determination, the two piglets (4%).

In young fattening were diagnosed: ascariasis, with an incidence ranging from 2.5 to 37.5% depending on breeding and season; trichocephalosis recording values between 5 - 7.5%, esophagostomosis, the boundary between 2.5 to 20% and
strongyloidosis, diagnosed three times, having within the limits from 2.5 to 5%.

II.4.4. Discussions

In our country, studies have been conducted with regional character reveals different levels of parasitism in pigs helmints.

In Galati County, Cambir et al. (2002) diagnosed in pigs from SUINPROD Independence farm and Cosmești infestations with *A. suum, Oesophagostomum* sp. and *T. suis* without specifying their prevalence.

In pigs slaughtered and parasitological examined in Calarasi county, between 1994 - 2004 have evolved infestations with *Trichinella spp.* (0.015%), *A. suum, Echinococcus granulosus* (5.9%) and *Oesophagostomum* sp. (Adam et al., 2004)


In Alba County, coproparasitologic exams made from pigs coming from household in area Ciugud in 1998, led to the diagnosis of infestation with *A. suum* (28.57%) and *O. dentatum* (25%). (Zelinschi et al., 1998)

In Olt County, Grecioiu (1992) believes that parasitic infestations are widespread in animals, the pigs moving ascaridiasis, esophagostomosis, strongyloidosis and metastrongylosis, without specifying their prevalence.

In Timis county, a study in the Teaching Station of the Faculty of Veterinary Medicine, between 2002 - 2003 revealed the following digestive helminths structure: the sows with piglets, in 2002, infestations with *Oesophagostomum* sp. (100%), *A. suum* (10%), *T. suis* and *S. ransomi*, 10% and in 2003 were diagnosticate infestations with *Oesophagostomum* sp. (100%), *A. suum* (25%) and *T. suis* (8.33%). In weaned piglets were identified the following, gastrointestinal nematodes profile: *A. suum* (10%), *S. ransomi* (5%) and *Oesophagostomum* sp. (55%). In young fattening, fat small pig, infestations have been diagnosed with *Oesophagostomum* sp.
(93.75%), A. suum (37.5%) and S. ransomi (6.25%). In large fat pigs have evolved: Oesophagostomum sp. (100%), A. suum (71.42%) and T. suis (35.71%).(Morariu, 2005)

A comparative analysis of our results with data exposed by other authors found a similarity in parasitic profile revealed characteristic pigs digestive helminthosis in our country, being ascariasis, esophagostomosis, trichocephalosis and strongyloidosis. Infestations have not been diagnosed with Macracanthorhynchus hirudinaceus acanthocephalan, although he plays in wild boar.

II.4.5. Conclusions

Epidemiological research carried out in Mures county, between 2003 - 2005, in different growth systems, with 5500 pigs led to the following:
1. Prevalence of pigs intestinal nematodosis reared in different farming systems in Mures county was 13.1%, 474 animals samples being diagnosed positive of the total 3600 examined.
2. Helminths profile varied by age category of pigs and growth system. In sows, from households (n = 60 in those three years), agro-livestock farms (n = 60 in the same period), that the intensive system (n = 60) was dominant Trichocephalus suis infestation with incidence varying between 20-60%, varies from one system to another increase in the household is the highest (60%). Infestation with Strongyloides ransomi was diagnosed in 20% animal from household system.
3. From boars (n = 180, each 60 of each farming system), the infestation with T. suis was detected in household and semi-intensive system, with prevalence between 20-40%..
4. In weaned piglets (n = 1800, 600 specimens examined by each system) were diagnosed infestations with: Ascaris suum, with an incidence between 4% and 40% in the intensive system households; Strongyloides ransomi, with values between 4% semi-intensive system and 20% in the complex of Band and Oesophagostomum dentatum identified in semi-intensive growth (4%) and 16% in households.
5. Share of intestinal piglet nematodosis returned ascariasis, diagnosed in 76.05% of the animals, followed by strongyloidosis with 13.02% and esophagostomosis, 10.92%.

6. The incidence of infestation by nematodes in young helminths fattening was: *Ascaris suum*, the extensivity of 2.5% in intensive breeding system and 37.5% in the household; *Strongyloides ransomi* between 2.5 - 5%, the same system; *Oesophagostomum dentatum* incidence between 2.5 - 5%, present only in households and *Trichocephalus suis*, now the same system with variations between 5 - 7.5%. Infestations have been reported throughout the year.

7. Seasonal dynamics of the infestation was characterized by the predominance helminths infestation with *T. suis* in breeding sows and boars from traditional farming system in winter in all three years studied (40% - 2003 60% - 2004 40% - 2005 sows, 40% - in 2003, and thereafter by 20% in boars) and reducing the incidence of parasitosis in the other three seasons, until her disappearance and semi system has evolved throughout the year.

8. Parasitosis diagnosed in young weaned piglets and fattening pigs: ascariasis, esophagostomosis and strongyloidosis had the strong seasonal fluctuations, was diagnosed in all farming systems, throughout the year, with different values of incidence from year to year.

II.5. RESEARCH ON HISTOPATHOLOGICAL INFESTATIONS WITH *ASCARIS SUUM* IN PIGS

II.5.1. Aims

Research carried out aimed to clarify some aspects of histopathology in natural infestations with *Ascaris suum* to pigs reared in household system, highlighting that microscopic lesions caused by adult parasites on intestinal mucosa, and visceral migration of larvae in respectively in mesenteric lymph nodes, liver and lung.
II.5.2. Material and methods

The research was conducted during August 2007 - April 2008 into two units namely Mureș Agrozootechnical Farm of Prison Tg. Mures and society PIG in the Band village. From pigs slaughtered at various occasions throughout the interval studied, mainly in winter season of 2007 were harvested organ pieces (intestine, mesenteric lymph nodes, lungs, liver) to carry out histopathological examinations. Histopathological examination was prepared in an Olympus BX41 optical microscope equipped with digital photographic images.

II.5.3. Results

Micro-lesions in the gut

In the parasite location area, the intestinal mucosa shows numerous changes due to the presence and action (mechanical, toxic, irritating): curved intestinal villous, “pin” shaped; villous settling toward parasite, altering their shape very much that, in some cases is much different than finger-like, globular or short appearances matter “anvil”; forming a debris barrier on the surface of intestinal mucosa and mucus membrane on the surface of the debris barrier; increasing the number of caliciform cells and increased caliciforme secretory activity, followed by vacuolar degeneration of caliciform cells; early alteration processes of some caliciform cell and discontinuities of villous epithelium; zonal disintegration of caliciform cells; top denudation of intestinal villous; zonal necrosis of enterocytes from the top of intestinal villous; vestiges looking of villous, with lymph-granulocytes infiltrated and debris on the surface of mucosa; small vessels congestion from gut axis of villous and disseminated intravascular coagulation; villous edema in the basement membrane and detachment of enterocytes from the basement membrane, followed by moderate generalized villous edema with moderate lymph-granulocytes infiltrate, and in an advanced stage pronounced villous edema with zonal loss of caliciform cells; lymphatic stasis in the central chilifer and massive lymph-granulocytes infiltration depth in intestinal mucosa; eosinophils infiltration in the intestinal mucosa
thickness; inflammatory exudates in lamina propria; basal and intercellular edema; inflammatory exudate on the surface of intestinal mucosa and debris in the intestinal lumen.

Micro-lesions in mesenteric lymph nodes

In the mesenteric lymph nodes collected from animals infected with *A. suum* can be highlighted so the traces of the shift in their larval forms and changes arise as a consequence of aggression from the gut, namely: traumatic parasitic paths with hemorrhagic necrotic debris; lymphocytic zonal necrosis; intra-sinus hemorrhage, lymphatic stasis and inflammatory exudate in the peripheral sinus; eosinophils infiltration in the peripheral lymph nodes, with degranulation and disintegration of eosinophils; reticular cell apoptosis; breaking zonal reticular network and zonal disruption of lymphatic sinuses.

Micro-lesions in the liver

Traces of parasite migration are present in the liver, their scale being very different from one area to another: traumatic intralobular paths appearance; collagen proliferation in areas affected by larval migration and eosinophilic infiltrate in the liver lobe periphery; trace the liver lobe (pseudolobule), with proliferation of connective tissue and interstitial fibrosis.

Lung micro-lesions

With a very particular structure, the lungs shows signs not so easy to interpret as the liver or lymph nodes. Traumatic paths are not so clearly defined due to cellular structure (with many spaces), but the effects of trauma are expressed, in the acute phase, by: congestion of vessels from inter-alveolar septum, intra-alveolar hemorrhage and alveolar walls rupture, affected alveoli number can be very high in some places.

In some lung bronchioli, are present lymph-histiocyte cell peribronchiolar infiltrate and congestion of vessels from peribronchiolar connective tissue even diffuse haemorrhage.
II.5.4. Discussions

Micro-lesions produced by *Ascaris suum* infestation can be systematized into two groups: those produced by adults parasites from the gut and those produced by visceral migration of larvae.

II.5.5. Conclusions

Histopathology researches conducted in natural infestations with *Ascaris suum* in pigs in order to clarify the alterations induced by adult worms, and migratory larvae have led to these:

1. In intestine, adults parasite compressive mechanical effect consist into a atrophy compression of mucosal, with varying degrees of curvature of the upper third of intestinal villous to subsidence of large portions of mucous, debris covered mucosa in these areas with the barrier role between intestinal mucosa and parasite.

2. Reactivity of intestinal mucosa to parasitic aggression is also expressed by caliciform cells hyperplasia accompanied by increased secretion them, thus creating a protective layer of the epithelium. Prolonged compressive action exerted by *A. suum* gradually reduce and eventually disappeared caliciform cells on large areas

3. Enterocytes react with degenerative and alteration processes, with their separation over wide areas of basal membrane, thus reaching the decommissioning of affected villous.

4. Intestinal vascular reactivity consist into congestion gradually and varied from one area to another, leading to the disseminated intravascular coagulation associated with impaired vascular wall permeability with edema and inflammatory exudates, intestinal lymphatic circulation is, in turn, affected lymphatic stasis was observed. These vascular changes underlying epithelial alterations.

5. Eosinophils are the dominant cellular component of intestinal cell infiltrate, being located mainly in deep mid-intestinal mucosa, as their advancement to the surface in order to achieve the role of cellular immune effectors, they degranulating and decay.

6. In mesenteric lymph nodes are present traumatic lesions with the appearance of representing areas of migration routes of the larvae.
of A. suum, lymphoid follicles kept their characteristic structurally morphological appearance.

7. In the liver, the migratory A. suum larvae producing traumatic paths with hemorrhagic-necrotic character and abundant eosinophilia infiltration, which, in old infestations are filled with fibrous connective tissue that have reparatory role

8. Pulmonary lesions are: inter-alveolar vessels congestion and those of peribronchial connective tissue, intra-alveolar hemorrhage, rupture of the alveoli walls, lymph-histiocytar peribronchial infiltrate, extensive epithelial proliferation of bronchiole, its zonal necrosis and proliferation of pneumocytes type 2.

II.6. EXPERIMENTAL RESEARCH ON TRICHINELLA SPIRALIS INFESTATION IN LABORATORY ANIMALS

II.6.1. Aims

The research conducted had the following objectives:

- clarifying lesions aspects in intestinal phase of the biology of Trichinella spiralis in experimental mice infestations;
- characterization of histopathological dynamics of lesions;
- setting up correlations between lesions and different infected doses of T. spiralis;
- establishment of morphological evolution issues in T. spiralis intestinal phase of the biological cycle;

II.6.2. Material and methods

The research was conducted between January to March 2010, in the DSV laboratory, Mureș, and FMV Cluj-Napoca, on a lot of 40 young mice divided into two groups, so:

- group A - 20 mice infected with a dose of 200 larvae per animal;
- group B - 20 mice infected with a dose of 1000 larvae / animal;

From day one p.i. were sacrificed daily for 14 days p.i. two mice from each group, from one animal were collected fragments of
jejenum, for pathological examination and for the second animal were considered in dynamic morphological changes of the parasites.

II.6.3. Results

II.6.3.1. Morphological evolution of *T. spiralis* in the intestinal phase

The average size of larvae at 24 hours pi (post-infestation) were 860 mm long, 10.15 mm in width and 26.80 mm above the posterior end. The average size of developed caudal bursa observed in this period were 6.8 / 9.6 mm.

At 48 hours pi, in the pre-adult female larvae was observed vulvar aperture, opened in third before the first appearance of the body and oocytes in the uterus.

4th day p.i. females shows characteristic morphological aspects of a complete physical development; measured the average length of 2060.5 mm and 10.9 mm wide at the anterior end, posterior end 30.9 respectively, vulvar aperture is 338 mm away from anterior end; males, smaller, measuring 1450 mm / 11.2 mm anterior end - 28.4 mm posterior end.

6th day constituted the first observation of hatched embryos, free in the small intestine, harvested from duodenum. They measured 107.9 / 7.45 mm. Next, the morphological evolution of intestinal stages of *T. spiralis* was followed by the 14th day, when finalizing the research carried out, without being seen significant changes.

II.6.3.2. Dynamic of lesions in intestinal phase of artificial infestation with *T. spiralis* in mice

Group A (di = 200 larvae / mouse) not present at 2 days of starting the experiment, changes in the intestinal mucosa, suggesting aggressive manage pests.

At 5 days pi, necrotic lesions appear as discrete area include a small number of affected villous, more appearing in their third top.

At 7 days after the start of the experiment, lesions appear as the components of the mucosal surface and those of her depth, villous height being different, or even absent in some areas. Intestinal
glands have apparently normal structure, but some of them have obvious necrosis appearance of "burning". Vessels reaction is evident, many appeared congested and by increasing vascular permeability have a relatively large quantity of extravasated fluids that are present as inter-glandular edema.

At 10 days after the start of the experiment lesions on the surface of intestinal mucosal are amplified, the vast majority of villous were affected and some even disappeared, and at 12 days, lesions are present but they are not more pronounced as the 10 days.

In group B, which received 1,000 larvae per animal, lesions appear quickly, so that in two days, the parasites action is felt, villous being mostly high, but their corion vessels appear congested and is currently a edema of moderate intensity, some of which appear atrophied glands and look for "burn".

After five days, the lesions progressing without major structural destructions. Villous number affected increases but does not exceed 50% of them. Congestion and edema are more pronounced both in the in depth chorion of mucosa and villous axis. In addition, parasites were highlighted in the intestinal mucosa, some more superficial (epithelial thickness) and others more deeply.

Lesions continued to progress faster; at eight days post-infestant intestinal villous are practically extinct on large areas, edema interglandular is very noticeable, lymphatic stasis is impressive both for lymphatic vessels in both villous corion and depth of the mucosa.

At 10-11 days, the intestinal mucosa is at least equally affected and the number of parasites surprised lining thickness is greater than 7-8 days.

And within 11-14 days of brutal changes across intestinal mucosa are maintained at levels comparable to the previous period. Persistence interglandular massive edema, glandular atrophy causes quite widespread and profound edema progressing to myolysis muscle where processes occur on relatively large areas.
II.6.5. Conclusions

The experimental research conducted on mice in order to clarify some aspects of histopathology in intestinal phase of *Trichinella spiralis* biology correlated with morphological evolution of the parasite in this phase led to the following:

1. The first elements that prefigure morphological sexual differentiation of *T. spiralis* muscle larvae administered orally to mice occurred at 24 hours pi for prospective male and female 40 hours.
2. Complete morphological development of adult *T. spiralis* ended four days pi.
3. Females larval release began at 6 days p.i. when embryos were outlined first free mobile jejunal mucosa.
4. At 14 days p.i. are still present by *T. spiralis* adults, male and female, jejunal level, with a characteristic body development.
5. In terms of histopathology, in both groups, developed lesions were correlated with the degree of infestation and biology of parasites.

II.7. RESEARCH ON INTESTINAL HELMINTHOSIS THERAPY IN PIG

II.7.1. Aims

- Checking the therapeutic efficacy of two molecules: avermectin and benzimidazole compound used to treat nematodes infestations in pigs;
- Determining how the treatments affect hematological constituents values and blood biochemical parameters in dynamic;

II.7.2. Material and methods

The research was conducted between February-April 2009; to check the effectiveness of both anthelmintic molecules were used 40 pigs, originating from household system, youth aged 8 to 10
weeks, divided into four groups; have been established following groups:

- Lot D - composed of 10 young weaned pigs, 15-17 kg body weight, increased household system, lot with natural helminths infestations treated with doramectin, as Dectomax commercial product, administered intra-muscular, dose of 0.3 mg/kg of body weight, single administration.
- Lot F - consisting of 10 animals of the same category as the previous group, treated as commercial product flubendazole Rombendazol F 10% soluble powder, administered in feed at a dose of 5 mg/kg bodyweight (ie 0.5 g powder Rombendazol F 10% to 10 kg body weight) two days consecutively.
- Lot MIN - 10 young pigs, infected and untreated controls.
- MNT group - 10 animals and treated uninfested control group, constituted for monitoring the occurrence of side effects caused by active substances tested. Of the 10 animals included in group, 5 were treated with doramectin, and the other five received flubendazole.

All groups were checked coproparasitologic by classical methods, individually, before applying treatment, establishing pre-treatment helminths profile, extensivity (%) and the intensity (eggs per gram faeces - OPG) infestations. Monitor the effectiveness of two active substances used, was made by coprological examination conducted on 7, 14 and 21 days post-treatment, determining the same index.

In all animals blood samples were taken from the jugular confluence to determine the values of hematology and blood chemistry issues.

Constituents hematology and biochemical parameters followed were: number of erythrocytes, total leukocytes, total eosinophils, total protein, albumin, gammaglobulin and enzymes aspartataminotranspherasis (AST) and alaninaminotranspherasis (ALT).

II.7.3. Results

In group D, treated with doramectin were diagnosed with infestations: *Ascaris suum*, the incidence of 50%, *Oesophagostomum*
dentatum (30%), Strongyloides ransomi (10%) and Trichocephalus suis (20%). Intensity of parasitism varied between 250 OPG, the minimum value recorded in the infestation with T. suis and 640 OPG in ascariasis.

Group F were revealed infestations with A. suum, the incidence of 30%, O. dentatum and T. suis from one single animal (10%) respectively S. ransomi in two pigs (20%). Intensity of parasitism in this group ranged between 200 OPG, O. dentatum and recorded an average of 367 OPG in A. suum.

In group MIN untreated control were diagnosed infestations with A. suum in 5 animals (50%) and T. suis in pigs in February, representing a prevalence of 20%. Intensity of parasitism was 380 OPG in A. suum infestation and 250 OPG (average) to T. suis.

In group MNT, treated and uninfested were not identified parasites infestations, animals were checked before the initiation protocol and coproparasitologic selected for this group for study of possible effects induced by two active.

Posttherapeutic in group D, infestation with A. suum showed a reduction in the incidence of 50% value anteterapeutic detected in 10% at 7 days posttherapeutic being diagnosed in one pig, for subsequent checks at 14 and 21 days may not be diagnosed. Doramectin had a higher efficacy in the treatment of swine ascariasis, leading to a reduction in disease extensity 7 days after administration of 80% for 14 and 21 days to express the maximum efficiency.

Infestation with O. dentatum, anteterapeutic diagnosed with an incidence of 30% wasn’t found posttherapeutic, doramectin demonstrating maximum efficiency, explained by the species feeding hematophagous.

S. ransomi, anteterapeutic diagnosed in an animal (10%) had a variable evolution posttherapeutic, the control achieved at 7 days was not diagnosed but at 14 days to recur to an animal (10%), and thereafter at last check, 21 days infestation was not present in batch.

Infestation with T. suis, with an incidence of 20% anteterapeutic, decreased after treatment, being diagnosed in a single animal (10%) at 7 days, for further checks may not be highlighted.
A comparative analysis of the effectiveness of doramectin on the four species of nematodes diagnosed it appears that acts primarily on the nutrition hematophagous parasites and intestinal location earlier, as confirmed by registered maximum effectiveness against *O. dentatum*. On nematodes eating intestinal chyme, tissue or those with posterior digestive localization (*T. suis*) molecule is also an increased efficiency, but requires a longer time period for exercising effect, control animals being negative only achieved at 14 days.

In group F ascariasis incidence decreased posttherapeutic to 0, since the day 7th, flubendazole showing maximum efficiency. The same posttherapeutic trend was found in infestations with *O. dentatum*, *S. ransomi* that all checks made. In trichocephalosis animals became negative at 14 days pt, posterior localization of parasites in the intestine being probably an obstacle to rapid exercise nematodicid effect by the active substance.

To control group, infected and untreated, coproparasitologic exams performed at the same time intervals showed the same evolution parasitosis diagnosed initially with close values of incidence.

It is noted that the prevalence of infestation with *A. suum* varied around a value of 50%, with limits between 40-60% *O. dentatum* was diagnosed checks conducted on 7 and 14 days for, extensivity infestation is 10, respectively 20%; infestation with *S. ransomi* has not evolved in this group during their experiments, and one with *T. suis* has remained constant, between 10-20% throughout the research.

In piglets from uninfested and treated group (MNT) no adverse effects occurred, local or general, as evidenced by clinical examination or subsequent administration of doramectin flubendazole.

After a comparative analysis of therapy results in swine intestinal nematodosis we can say that both active substances tested showed high efficacy, is causing negativity parasitological lots of animals used at various intervals from 7 - 14 days for.
II.7.5. Conclusions

Therapeutic research (using doramectin and flubendazole) on pigs gastrointestinal nematodosis in Mures county, made between 2003 to 2005, a flock of 40 young pigs aged 8-10 weeks divided into four groups - D, F, MIN and MNT, reared in the household system, led to:

1. Therapeutic investigations with the two preparations revealed the following: doramectin at a dose of 0.3 mg / kg of body weight, IM injection, tested on a group of 10 piglets had an increased effectiveness in controlling nematodosis in pigs causing reduction of 80 % of infestation with *A. suum* in seven days posttherapeutic and 100% at 14 and 21 days p.t. The situation is similar trichocephalosis where to seven days for infestation was found to reduce by 50%, because 14 and 21 days may not be diagnosed. In esophagostomosis incidence fell from 30% to zero to seven days p.t. and was maintained throughout the tests; in strongyloidosis to seven days p.t. infestation was not present, 14 days p.t. recurrence in 10% of animals.

2. Flubendazole, a dose of 5 mg / kg of body weight in food, 2 consecutive days using 10 piglets had a therapeutic efficacy of 100% infestation with *A. suum, O. dentatum* and *S. ransomi*, examinations carried 7, 14 and 21 days p.t. negative. The preparation of *T. suis* action was delayed from 10% infestation was negative in 14 days p.t.

3. At the same time, the control group, consisting of 20 animals presented during experiments same infestations diagnosed pre-treatment: *Ascaris suum* between 49-60%, *Trichocephalus suis*, occurring between 10-20% and the infestation with *O. dentatum*, 10-20%.

4. Both, flubendazole and doramectin administered in indicated dosages, no adverse reactions induced in the three experimental groups. Witnesses and those uninfected and infected treated and untreated behaved normally.

5. In groups D and F were recorded pre-treatment state of erythropenia, because in 21 days posttherapeutic increase the erythrocyte.
6. Evolution of total leukocytes was characterized by the presence of leukocytosis pre-therapeutic status in groups D (21.22 g / l) and F (22.78 g / l) has regressed to the reference values for 21 days. in both groups.
7. Total eosinophils were elevated pre-treatment of lots infested with nematodes, D (5.65 g / l) and F (6.55 g / L); at 21 days posttherapeutic the level decreased.

II.8. STUDY OF HELMINTHOFAUNA IN WILD BOARS (SUS SCROFA L.) FROM MURES COUNTY

II.8.1. Aims

Research undertaken between 2006 - 2009, on wild boar collected from hunting areas in Mureș county watched:
- Specify helminths profile by identifying parasites on morphological criteria;
- Determining prevalence and determine the type of helminthosis infestation, mono - or poly-specific, of wild boar populations hunting areas in the county of Mureș;
- Highlighting some correlations between age and sex of animals hunted and helminths diagnosed;
- Highlighting some microecology aspects of infestation with nematodes:
  - Statistical calculation of population parameters: the herd number (EN), sex index (SI), sex ratio (SR);
  - Determination preferential habitat for helminths species with digestive localization;

II.8.2. Material and methods

The research was conducted between 2006 - 2009 on a herd of 50 wild boar harvested from eight hunting areas spread over the Mureș county.

Harvesting visceral mass was done consecutively of hunting parties organized in the legal season, between August 1 to February 15.
Parasites harvested and preserved in alcohol, were examined microscopically, photographed, after being carried out their systematic classification based on morphological criteria.

Micro-ecology studies have required the use of quantitative methods - counting all nematode parasites harvested every species, to obtain herd numbers, index of sex determination and sex ratio.

II.8.3. Results

II.8.3.1. Specify the wild boars helminths profile in Mureș County.

The data obtained shows that have been identified based on morphological criteria, 12 species belonging to helminths classes Cestoda, Nematoda and Acantocephala without observable state of parasitism by Trematoda class flat worms.

From class Cestoda were identified metacestodes Cysticercus tenuicollis and Echinococcus granulosus with localization in liver and abdominal serous. Metacestodes are not a taxon, they are all intermediate stages of evolution of a cestode, from egg to larval forms.(Wardle și McLeod, 1952)

From class Nematode were highlighted nine species with different locations: Ascaris suum, Globocephalus urosubulatus, Metastrongylus sp., Trichocephalus suis, Gongylonema pulchrum, Ascarops strongylina, Physocephalus sexalatus, Trichinella sp. și Strongyloides ransomi.

Acantocephala class present similar characteristics from cestodes and nematodes; in this class have been identified one representative, namely Macracanthorhynchus hirudinaceus.

II.8.3.2. Determining the prevalence of helminths infestation diagnosed

Helminths infestation were highlighted in 49 hunted animals, representing an overall prevalence of 98%; in a single animal, adult female, were’nt diagnosed helminths infestations.

Of the 49 positive animals, 2 were diagnosed with a single species infestations helmints (4.1%) and 47 were outlined polispecific infestations (95.9%). Poly-specific infestations were found in the presence a different number, between 2-6 species, of
one animal. The most commonly highlighted association of two species (20 = 42.6%), followed by pairings of three species helminths present in every 17 of the 49 infected animals, representing a prevalence of 36.2%.

Were detected associations of 4 parasitic species to 6 animal (12.8%), with five species in three wild boars (6.3%) and a single animal was diagnosed a polispecific parasitism increased with presence in different organs of helminths six species, representing a prevalence of 2.1%.

II.8.3.3. Establish a correlation between age and sex of hunted animals and helminths diagnosed

*Cysticercus tenuicollis* was revealed in six pigs (12%), affecting males and females equally, but predominantly adult animals.

*Echinococcus granulosus* developed in two pigs (4%), both adults, one male and one female.

*Ascaris suum* infestation diagnosed in six animals (12%) evolved mainly in adult animals, as evidenced reduced intensity infestations in four adults (66.7%) and two young animals, less than one year (33.3% ). Of the six infected pigs, four were male (66.7%) and two females (33.3%).

*Globocephalus urosubulatus* was identified in 20 animals (40%), predominantly in adults were diagnosed in 16 specimens of 20 (80%), in relatively equal proportion in the sexes: 11 female (55%) and 9 males (45%).

Lung nematode *Metastrongylus elongatus* showed the high prevalence of the highlighted helminths species, affecting 43 animals (86%). It affected mostly adults, were identified in 31 pigs (72.1%) that females (58.1%).

*Strongyloides ransomi* infestation developed in three pigs (6%), affecting two young animals (66.7%) and one adult (33.3%) and two females (66.6%) and one male (33.3 %).

*Trichocephalus suis* infestation developed in 17 pigs (34%), being a youth parasitosis. Of the 17 animals, infestation was present in 11 of category youth under the age of 1 year (64.7%) and six
adults (35.3%) ; distribution according to sex positive cases revealed the presence of infestation at 8 females (47%) and 9 males (53%).

*Trichinella sp.* was highlighted in a single animal (2%), being about one adult male.

*Gongylonema pulchrum*, localized esophageal, was present in 14 cadavers (28%) were diagnosed only in adult animals, males and females equally.

Gastric nematode *Ascarops strongylina* affected 3 animals (6%), being present only in adult male. The situation is similar for other gastric nematode, *Physoccephalus sexalatus* who was present at a single adult male (2%).

*M. hirudinaceus* acanthocephalan recorded total prevalence of 44%, affecting 22 animals, was diagnosed in 16 adults (72.7%) and females in approximately equal measure - representing 54.5% and males 12 (45.5%).

**II.8.3.4. Micro-ecological aspects of infestation with nematodes in wild boar**

Statistic population parameters were determined: number of livestock helminths populations identified, sex index and their sex ratio.

Calculation of these parameters was possible only to helminths nematode populations in morphological criterion allowed their differentiation in male and female and that could be harvested all individuals existing in their characteristic biotope. Thus, these indices have been established in populations *Globocephalus urosubulatus*, *Trichocephalus suis*, *Gongylonema pulchrum*, *Ascarops strongylina*, *Physoccephalus sexalatus* și *Macracanthorhynchus hirudinaceus*.

**II.8.5. Conclusions**

Research carried out in order to specify the digestive helminths profile in wild boar, made between 2006 - 2009 on a total of 50 animals collected from eight hunting areas dispersed in Mureș county, led to the following:
1. Of the 50 wild boar examined were diagnosed with infestations helminths to 49, revealing a prevalence of 98%. Mono-specific infestations have developed in two animals of the 49 parasitized (4.1%), the remainder being diagnosed condition of poly-parasitism (95.9%).

2. 12 helminths species were identified: two *Cestode* class, nine species of nematode and one from *Acanthocephala* class. Bio-helminths species predominated in number 7, geo-helminths were represented by four species; was recorded and *Trichinella* spp., nematode with a particular cycle, not classified in two categories.

3. Diagnosed parasitic profile was the following species that showed a different prevalence: *Ascaris suum* (12%), *Globocephalus urosubulatus* (40%), *Strongyloides ransomi* (6%), *Trichocephalus suis* (34%), *Gongylonema pulchrum* (28%), *Ascarops strongyliina* (6%), *Physcephalus sexalatus* (2%), *Macracanthorhynchus hirudinaceus* (44%), *Cysticercus tenuicolis* (12%), *Echinococcus granulosus* (4%), *Metastrongylus elongatus* (86%) and *Trichinella sp.* (2%).

4. The parasitized organs were lung, the diaphragm lobe (*Metastrongylus* spp.), followed by intestine, respectively jejunum, biotope of three species (*A. suum, G. urosubulatus* and *M. hirudinaceus*) and stomach, typical biotope for two species: *A. strongyliina* and *P. sexalatus*.

5. Number of all helminths populations harvested from the 49 infected wild boars was 1503, with variations dependent parasitic species.

6. Sex index Registered changes from species to species, between 0,16 – 0,88..

7. The proportion of male and female - sex ratio has registered the following values: *G. pulchrum* 1:1 - 1:7 (1:2,5); *A. strongyliina* 1:2 - 1:4 (1:2,8), *P. sexalatus* 1:7; *G. urosubulatus* între 1:1 - 1:5,3 with 1:2,4 average; *T. suis* 1:0,2 - 1:3 (1:1,5) and *M. hirudinaceus* between 1:0,8 - 1:8 with 1:1,7 average.

8. Segments of the digestive tract, jejunum was found to be most frequent and intense parasite.

9. *Trichinellosis* was diagnosed in a wild boar (2%).