

**INCIDENCE AND TREATMENT OF CESTODES  
OF DOGS IN KERALA  
WITH SPECIAL REFERENCE TO  
THE TAENIID SPECIES**

By

**P. NARENDRAN NAIR**

**THESIS**

Submitted in partial fulfilment of the  
requirement for the Degree

**Master of Veterinary Science**

Faculty of Veterinary and Animal Sciences  
Kerala Agricultural University

Department of Parasitology

COLLEGE OF VETERINARY AND ANIMAL SCIENCES  
Mannuthy - Trichur

**1982**

## DECLARATION

I hereby declare that this thesis entitled "INCIDENCE AND TREATMENT OF CESTODES OF DOGS IN KERALA WITH SPECIAL REFERENCE TO THE TAENIID SPECIES" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

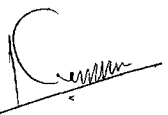
Mannuthy,  
25-10-1982.



P. NARENDRAN NAIR.

CERTIFICATE

Certified that the thesis entitled "INCIDENCE AND TREATMENT OF CESTODES OF DOGS IN KERALA WITH SPECIAL REFERENCE TO THE TAENIID SPECIES" is a record of research work done independently by Sri.P. Narendran Nair under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship, or associateship to him.



DR. C.PYTHAL

(Chairman, Advisory Board)

Assistant Professor,

Department of Parasitology,

College of Veterinary & Animal Sciences,

Mannuthy : Trichur.

Mannuthy,  
25-10-1982.

## ACKNOWLEDGEMENT

I place on record my most sincere gratitude to Dr.C.Pythal, Assistant Professor of Parasitology, under whose inspiration and guidance this work was carried out.

I am extremely thankful to Dr.K.Rajamohan, Professor of Parasitology; Dr.K. Madhavan Pillai, Associate Professor of Parasitology, and Dr.P. Prabhakaran, Associate Professor, Veterinary Public Health, members of the Advisory Committee for their valuable advice and encouragement throughout the work.

I wish to express my deep gratitude to the staff of the Department of Parasitology and to Dr.C.K. Ouseph, Veterinary Surgeon, Trichur Municipality for the help rendered during the studies.

I am deeply indebted to Dr.R.Kalyanasundaram, Associate Director of Research (Veterinary), Kerala Agricultural University, for his valuable help throughout the studies and for taking photographs.

I wish to express my deep sense of gratitude to Dr. M. Krishnan Nair, Dean, College of Veterinary & Animal Sci., for affording all the facilities for the conduct of the work.

The valuable help and co-operation rendered throughout the work by my colleagues is acknowledged here.

I am grateful to Sri.T.D.Jose for typing the manuscript.

Lastly, but not in the least, I place on record my deep sense of gratitude to the Kerala Agricultural University for granting me merit scholarship for the entire period of study.

P. NARENDRA NAIR.

## TABLE OF CONTENTS

			<u>Page No.</u>
INTRODUCTION	..	..	1
PRESENT INVESTIGATION	..	..	3
MATERIALS AND METHODS	..	..	5
INCIDENCE OF CESTODES - REVIEW	..	..	16
RESULTS	..	..	32
TREATMENT OF CESTODE INFECTION - REVIEW	..	..	47
RESULTS	..	..	58
TABLES	..	..	61
DISCUSSION	..	..	74
SUMMARY	..	..	79a
REFERENCES	..	..	81
ABSTRACT	..	..	..

---

## LIST OF TABLES

Page No.

Table I	Incidence of cestodes in dogs assessed by autopsy screening	
	a) Overall incidence	61
	b) Overall incidence according to host age groups	62
Table II	Incidence of cestodes in dogs assessed by autopsy screening	
	a) Incidence in host age groups upto 6 months	63
	b) Incidence in host age groups above 6 months upto 1 year	63
	c) Incidence in host age group above 1 year upto 2 years	64
	d) Incidence in host age group above 2 years upto 5 years	64
	e) Incidence in host age group above 5 years	64
Table III	Intensity of Dilepidid cestode infection in dogs	
	a) Intensity in host age group upto 6 months	65
	b) Intensity in host age group above 6 months upto 1 year	65
	c) Intensity in host age group above 1 year upto 2 years	65
	d) Intensity in host age group above 2 years upto 5 years	66
	e) Intensity in host age group above 5 years	66
Table IV	Intensity of Taenid cestode infection in dogs	
	a) Intensity in host age group upto 6 months	67
	b) Intensity in host age group above 6 months upto 1 year	67
	c) Intensity in host age group above 1 year upto 2 years	67
	d) Intensity in host age group above 2 years upto 5 years	67
	e) Intensity in host age group above 5 years	67

Table V	Incidence of cestodes in dogs assessed by faecal sample examination	68
Table VI	Incidence of cestodes in dogs assessed by faecal sample examination	
	a) Incidence in host age group upto 6 months	69
	b) Incidence in host age group above 6 months upto 1 year	70
	c) Incidence in host age group above 1 year upto 2 years	70
	d) Incidence in host age group above 2 years upto 5 years	70
	e) Incidence in host age group above 5 years	70
Table VII	Efficacy of anthelmintics against <u>Taenia hydatigena</u>	71
TableVIII	Efficacy of anthelmintics against <u>Dipylidium caninum</u>	72
Table IX	Efficacy of anthelmintic against <u>Echinococcus granulosus</u>	73



## LIST OF PLATES

- Plate I Fig. 1 Taenia hydatigena gross worms  
 Fig. 2 Taenia hydatigena scolex  
 Fig. 3 Taenia hydatigena immature segment
- Plate II Fig. 1 Taenia hydatigena mature segment  
 Fig. 2 Taenia hydatigena gravid segment  
 Fig. 3 Taenia hydatigena ova
- Plate III Fig. 1 Echinococcus granulosus gross worms  
 Fig. 2 Echinococcus granulosus immature worm  
 F
- Plate IV Fig. 1 Echinococcus granulosus mature worm  
 Fig. 2 Echinococcus granulosus gravid specimen  
 Fig. 3 Echinococcus granulosus gravid segment with
- Plate V Fig. 1 Dipylidium caninum gross worms  
 Fig. 2 Dipylidium caninum scolex  
 Fig. 3 Dipylidium caninum immature segment
- Plate VI Fig. 1 Dipylidium caninum mature segment  
 Fig. 2 Dipylidium caninum gravid segment  
 Fig. 3 Dipylidium caninum egg packet
- Plate VII Fig. 1 Joyeuxiella pasqualei gross worms  
 Fig. 2 Joyeuxiella pasqualei scolex  
 Fig. 3 Joyeuxiella pasqualei immature segment
- Plate VIII Fig. 1 Joyeuxiella pasqualei mature segment  
 Fig. 2 Joyeuxiella pasqualei gravid segment  
 Fig. 3 Joyeuxiella pasqualei ova
- Plate IX Fig. 1 Diphyllobothrium latum gross worm  
 Fig. 2 Diphyllobothrium latum mature segment  
 Fig. 3 Diphyllobothrium latum ova
- Plate X Fig. 1 Hydatid cysts in lung of sheep  
 Fig. 2 Hydatid cyst - brood capsules and daughter  
 Fig. 3 Cysticercus tenuicollis  
 Fig. 4 Taenia hydatigena attached to the duodenal  
 mucosa of pup.

# *Introduction*

---

## INTRODUCTION

The domestic dog, Canis familiaris L., is a cosmopolitan animal living in close contact with man as well as various species of animals, including livestock like the herbivores of economic importance and pets like the cat, as a versatile benefactor of mankind. Because of its ubiquitous distribution and intimate association with man, the dog enjoys an important position in the day-to-day life of human beings all over the world.

The dog population, comprising of owned animals living under the control of their masters and the unowned ones having uncontrolled existence in every conceivable sort of habitat, is substantial in almost all regions of our country. The wide distribution with ample chances for extensive movements in urban as well as feral habitats and the carnivorous feeding habits make the dogs very prone to high degree of invasion with innumerable species of parasitic organisms. The slack set up of veterinary as well as public health provision enforcements in the country provides more than adequate opportunity for the dogs to thrive as disseminators of the parasites harboured by them.

Among the parasites liable to be encountered in dogs, the cestodes (subclass: Cestoda; Class: Cestoidea; Phylum:

Platyhelminthes) are an important category in as much as they constitute a rather large group of organisms with considerable pathogenic effects to the hosts and also cause substantial economic losses and severe public health problems. The cestodes of dogs, and more particularly the taeniid species of the group, are also important in that they are difficult to be controlled and eradicated because of their biological peculiarities as well as the ecological and regulational handicaps.

Available information reveals that systematic study with regard to the incidence as well as intensity of cestode infections in dogs and treatment of the infections has, so far, not been made in Kerala. The present investigation is therefore undertaken to collect data regarding the prevalence of cestode infection in dogs in Kerala and the treatment which could be undertaken for controlling the infections. The information gathered is expected to provide basis for an effective programme for the scientific eradication of these important parasites.

# *Present Investigation*

---

## PRESSENT INVESTIGATION

The work connected with the present studies extended for a period of almost 2 years from October, 1930 and comprised of a survey on the incidence of cestode parasites in dogs, with observations on their morphology as well as specific identity as also investigations on the treatment of cestode infections of dogs.

In all, four species of cestodes were encountered in dogs, detailed morphology and specific identity of all of which are reported.

The incidence of cestodes in dogs was determined by employing the alternate methods of either carrying out autopsy screening of the animals or conducting examination of faecal samples from the animals as was possible with relevance to the availability of the specimens for examination. Dogs procured from in and around the Mannuthy area or cadavers available after experimental uses of dogs by various departments of the College of Veterinary & Animal Sciences, Mannuthy formed materials for the autopsy screening while faecal samples collected through the courtesy of various veterinary institutions in Trichur district formed the materials for the clinical examination.

The rate of occurrence and specific identity of the

cestodes encountered in dogs as well as the probable identity of whatsoever tapeworm ova encountered in the faecal samples were also determined, during the study, with relevance to the age and sex of the host animal.

Cestode species like Dipylidium caninum, which was present as natural infection among a number of the animals examined, and Taenia hydatigena as well as Echinococcus granulosus which were experimentally got developed in dogs, were subjected to anthelmintic treatment using a number of recommended medicines at specific dose rates under controlled conditions and under controlled anthelmintic efficiency evaluation methods. The data, thus gained, were critically evaluated with reference to the effect of the drugs on the parasites as well as the host, if any, and with reference to the data available in the record.

The detailed informations gathered during the studies are presented, with necessary correlative reviews to form basis for a scientific method for controlling the cestode parasites of dogs.

# *Materials and Methods*

---



## MATERIALS AND METHODS

The following methods were resorted to with reference to the appropriate type of material during the studies.

### 1. Autopsy screening of animals for cestode parasites

The dogs procured for the studies and the cadavers in toto or the small intestine which form the relevant material were subjected to detailed examination for recovering all stages of cestodes. Live animals were put to death by administering appropriate dose of strychnine sulphate intramuscularly after ensuring proper control. They were then subjected to detailed examination to critically assess their age and sex, as well as general condition. The animals were opened up by putting single longitudinal incision along the midventral line extending from the perianal region forward to the jowl so as to expose the body cavities and viscera, which were subjected to examination for pathological conditions. Subsequently, the animal was disembowelled by severing the mesenteric connections and taking out the abdominal organs including the kidneys together with the thoracic organs disconnected from the cavity and with the trachea and oesophagus intact. The alimentary canal was then separated from the rest of the organs by blunt separation, after checking up the ducts of the associated glands as well as organs like the gall bladder and the pancreas for presence of parasites by careful dissections and after separating the

parasites, if any, for further examination. The different segments of the alimentary canal, namely the oesophagus, the stomach, the small intestine (in divisions as the duodenum, jejunum and ileum), the caecum, the colon and the rectum, were each got separated from the other portions by careful blunt dissections to avoid severing any cestode strobila present and by taking care to extricate in toto whatever parasitic materials were encountered during the process. Each of the segments of the alimentary canal was subsequently subjected to gentle flushing out with normal saline solution (0.85% sodium chloride solution) with the help of a metal syringe of 500 ml capacity and the flush outs gathered in separate glass beakers of suitable size so as to collect the parasites located in the different portions. The washings were put aside separately for subsequent examination.

The small intestine, which is the usual site of cestode was subjected to further detailed examination, for which it was separated into divisions as the duodenum, jejunum and ileum by carefully incising, in circles, the serosa and muscular wall at the appropriate levels and then gently disrupting the softer internal lining by gently pulling one portion away from the other so as to avoid breakage of any strobila present in the region, and by carefully gathering

the parasites encountered, if any, during the process. In every case, care was taken to make note of the location of scolex of cestodes, if any present, with reference to the portion of the alimentary canal being examined.

After thus separating the alimentary canal into the various distinct natural regions and having the unattached contents of each region removed by gently flushing out with normal saline, each portion was carefully cut open with the help of a pair of scissors and laid spread flat on separate enamel iron trays containing sufficient quantities of normal saline solutions to just cover the material. Careful examination of the inner (lumen) surface of each spread-opened portion was then carried out with the help of magnifying glass to locate cestodes present, all of which were then carefully removed from the organ with the help of a camel hair brush and kept in normal saline solution in separate marked petri dishes for detailed study later on. The mucosa of each portion of the alimentary canal was then scraped off gently applying the side of a clean glass slide against the organ at one end with appropriate pressure and slowly drawing the slide to the other end over the organ, thereby dislodging the mucosal lining in shreds along with villi into the saline solution itself, simultaneously pulling out the organ from the solution by holding with a pair of forceps

at the tip where the process was commenced. The scraped organ was then carefully examined for any lesions containing parasites before putting the same aside for disposal. The normal saline solution containing the mucosal scraping was then carefully transferred from the tray into a beaker and materials if any left over in the tray were got dislodged and also transferred into the beaker by repeated washing of the tray with normal saline solution.

The wash contents from each portion of the alimentary canal already sedimented, were decanted and subjected to repeated processes of suspension in adequate quantity of normal saline solution, sedimentation and decantation, until all possible extraneous material was removed along with the discarded supernatants and the parasites present were got cleared of the intestinal contents and debris as far as possible. The cestodes from the collections were then transferred, on the basis of their apparent morphological identity to the specific petri dishes already holding the specimens gathered from the identical portion by examining the concerned organ after opening up the same.

Subsequently, collection of the mucosal scraping in normal saline solution from each region was resuspended in adequate additional quantities of normal saline solutions and then decanted after getting settled, the process being

repeated until all possible non-parasitic material could be washed out, after which the cestodes from the collections were transferred to the appropriate containers holding morphologically identical specimens gathered from the wash contents as well as the opened up portions, described above.

The cestodes collected through the above processes from each region of the alimentary canal were subjected to cursory examination under a binocular dissection microscope to make out their gross morphological features and then subjected to assortment on the basis of the resultant tentative identification. Numerical strength of each category of cestodes was determined by making specimen countings by transferring individuals to a separate petri dish containing normal saline solution. Further observations warranted to be made on individual specimens, in vivo in the normal saline solution, with regard to the tonicity and organospecific activity as well as gross morphology and activity, if any, of specific structures or products like the hook and the ova were recorded separately with regard to each specimen under examinations with the binocular microscope.

The cestodes collected during the process were then relaxed by placing the specimens in tap water for variable periods of time, as required. The individual specimen was then subjected to critical studies with regard to the

measurement parameters relevant to specific aspects like the length as well as breadth of the different regions of the specimen including the holdfast structures and numerical data on hooks as well as number of proglottids in different portions of the strobila. The numerical data on ova carried in gravid segments of each species of cestode were determined by carefully testing out all portions of random specimens of gravid segments from a minimum number of ten strobila in each case in normal saline solution thoroughly with the help of a pair of mounted needles, subjecting the resultant suspension to complete filtration through clean polythene sieves of suitable sizes and by making counts of the eggs in three measured aliquotes of uniformly suspended filtrate under precision microscope, finally permuting out the total number of ova in a segment from the available data.

Cestodes required for morphological studies carried out for determination of their specific identity were selected from among the relaxed specimens of each group at random with due consideration to size or relative stage of development of parasite. Specimens or portions of specimens cut in lengths suitable for mounting were subjected to necessary flattening and fixation in 10% formalin in the routine manner. The fixed specimens were then subjected to the routine procedure of washing for removal of formalin, staining in acetic alum

carmine, necessary clearing and softening after which they were mounted in canada balsam. For the study of the rostellar hooks, enface views of the rostellar pad, bearing the rows of hooks, were prepared by mounting materials carefully cut off from the parasite and stained with the differential trichrome stain according to the procedure of Horen (1957). The morphology of ova and the related structures from different specimens were studied by examining slide preparation of freshly teased out materials contained in normal saline under the microscope.

In all cases data relating to the length and width parameters were gathered by studying lots of ten specimens and the morphological details recorded on the basis of examination of a minimum of ten specimens. Morphology of eggs was made out on the basis of details pertaining to a minimum of hundred ova and information on hooks relate to the data gathered by examination of a minimum of 100 hooks, in each case. The macroscopic measurements are recorded in millimeters and the microscopic measurements in microns.

## 2. Examination of faecal samples for cestode infections

Of the faecal samples examined for cestode infections, those samples collected from dogs personally were taken in clean petri dishes and freshly subjected to detailed

examination for the infections while those samples obtained through the courtesy of the different veterinary hospitals were arranged to be collected and put directly into marked clean polythene containers of 50 ml capacity, each carrying 10 ml of a 2% potassium dichromate solution in 10% formalin, that served as a preservative, so that the sample could be subsequently brought to the laboratory periodically, for detailed examination according to convenience.

Each sample freshly subjected to examination was first observed for the presence of segments or strobila therein with naked eye as well as with the help of a magnifying glass by using a pair of mounted needles to turn or tease out the material as required; the cestode material, encountered, was transferred to a marked petri dish containing normal saline solution for detailed study. The sample was then subjected to clinical examination by transferring a weighed out portion of 1 g of the same into a mortar, triturating it with 15 ml of water and examining 0.05 ml of the suspension<sup>a</sup> on a clean slide under the microscope, when cestode ova encountered were examined for specific identity and counted, and number of each type of ova per gram of the faeces ascertained by multiplying the count number with 300. With regard to preserved samples, the entire material in each container was thoroughly mixed up in the preservative with the help of a pair of mounted needles and then sieved to collect the worms, which



were washed out in water and examined thoroughly for determination of specific identity, while the filtrate was allowed to sediment, so that the latter could be examined for cestode eggs. In all cases, the same parameters as employed in the case of specimens and materials from autopsy screening were resorted to for recording the observations.

### 3. Assessment of efficacy of anthelmintics

For the assessment of the efficacy of anthelmintics against tape-worm infections in dogs, controlled anthelmintic trials were carried out with regard to infections with Taenia hydatigena and Echinococcus granulosus while clinical trials were carried out against Dipylidium caninum. For the controlled anthelmintic trials, artificial infections with Taenia hydatigena and Echinococcus granulosus were set up separately by feeding experimental pups varying in age from 1 to 2 months with 5 viable protoscolices from Cysticercus tenuicollis for the former and 2000 viable protoscolices from Hydatid cysts for the latter, the protoscolices in both having been collected from larval materials gathered from the slaughter house. The experimental animals were grouped according to periodicity of infection and the random animals from each group were sacrificed to determine the patency

and the intensity of infections. Each animal was maintained in separate metal cages of appropriate floor mesh size and provided adequate quantity of nourishing food. The experimental animals were examined daily for health condition and clinical manifestation of parasitism as well as for the signs, if any, of parasitic infections. Controlled trials were carried out after setting up a known intensity of infection with the relevant parasite which was fixed up as 5 worms in the case of Taenia hydatigena and about 1000 worms in the case of schinococcus granulosis. Measured quantity of the different anthelmintic providing doses of the standard recommendation, half of the standard and double the standard were each administered to the concerned animal in empty stomach, and the animals kept under close watch for 30 minutes after which they were fed their diets. Each animal was subsequently sacrificed after 48 hours of medication, autopsied and screened for the parasites. The entire faecal material passed by each animal after medication and till the time of its sacrifice was also subjected to detailed examination for the presence of scolices, strobila, proglottids or eggs, each of which was examined carefully with regard to viability, disruptions, or degeneration by standard methods. Clinical trials were carried out after assessing the intensity of infection with

Dipylidium caninum by examining the entire faecal material passed every day for a consecutive period of three days before the treatment for presence of gravid segments, egg packets, strobila or scolices. The treatment was carried out with each drug as detailed above and efficacy assessed by autopsy screening conducted after 48 hours as well as by examination of entire faeces voided in each case. The findings were evaluated as in the case of the controlled anthelmintic trial described above.

# *Incidence of Cestodes Review*

---

## INCIDENCE OF CESTODES

According to the available literature, the following species of strobilate cestodes have been reported in dogs in different parts of the world.

Taenia antarctica Fuhrmann, 1922 - Antarctica.

T. cervi Christiansen, 1931 - Europe.

T. crassiceps (Zeder, 1800) Rudolphi 1810 - Alaska, Russia, North America.

T. hydatigena Pallas, 1766 - cosmopolitan.

T. krabbei Momez, 1879 - Alaska; U.S.S.R.

T. ovis (Cobbold, 1869) - Cosmopolitan.

T. pisiformis (Bloch, 1780) - cosmopolitan.

T. punica Cholodkovsky, 1908 - Tunis.

T. rileyi Loewen, 1929.

Multiceps brauni Setti, 1897 - Italy.

M. gaigeri Hall, 1916 - U.S.A.

M. glomeratus Railliet et Henry, 1915 - Experimental, Africa

M. multiceps (Lesk, 1780) Hall, 1910 - cosmopolitan.

M. packii Christenson, 1929 - Experimental, Minnesota.

M. skrajabini Popov, 1937 - Russia.

M. smythi Johns, 1957 - Dublin (Ireland).

Hydatigera balaniceps Hall, 1910 - U.S.A.

Echinococcus granulosus (Batsch, 1786) Rudolphi, 1801 -  
Cosmopolitan.

- E. multilocularis Leuckart, 1863 - Japan.
- Monordotaenia honessi, Hendrickson et al., 1975 - Wyoming, U.S.A.
- Dipylidium caninum Wittenberg, 1952 - Cosmopolitan.
- D. buecaninoti Tubangui, 1925 - Philippines.
- Diplopylidium nolleri Skrajabin, 1924 - Cosmopolitan.
- Joyeuxiella pasqualei (Diamare, 1893) - Cosmopolitan.
- J. echinorhyncooides (Sons, 1839) Wittenberg 1932 - experimental, Nubia.
- Mesocestoides lineatus Goze, 1782 - Cosmopolitan.
- M. litteratus Batsch, 1786 - Europe.
- M. tenuis Meggit, 1931 - Burma, India.
- M. variabilis Mueller, 1927 - U.S.A.
- Diphyllobothrium alasense Rausch et Williamson 1958 - Chevaka, Alaska.
- D. cordatum (Leuckart, 1863) - Greenland.
- D. dalliae Rausch, 1956 - Alaska.
- D. granata Baerigalupo, 1948 Argentina.
- D. latum Linnaeus, 1758 - Cosmopolitan.
- Spirometra mansonoides, Mueller, 1935.
- Pyramnocephalus phocarum (Fabricius, 1936), Atlantic, Greenland, Alaska.

The available record gives the following incidence of cestodes in dogs in India:

- Taenia hydatigena Pallas, 1766 from Lahore, Gaiger, Sondhi.  
T. ovis (Cobbold, 1869) - Lahore, Southwell.  
T. pisiformis (Bloch, 1780) - Lahore and Punjab by Southwell;  
 Gaiger.  
Multiceps gaigeri Hall, 1916 - Lahore by Gaiger; Sondhi  
M. multiceps Lesk, 1780 - Lahore by Gaiger.  
M. serialis Gervais, 1847 - Lahore, Calcutta by Gaiger;  
 Sondhi, Angul, Orrisa by Southwell.  
Echinococcus granulosus (Batsch, 1786) Rudolph, 1801 -  
 Lahore by Gaiger; Sondhi; Berhampur, Bengal by Southwell.  
Dipylidium caninum Wittenberg, 1932. Lahore, Punjab by  
 Gaiger; Sondhi. Indian Museum and Ceylon by Southwell.  
Mesocestoides lineatus Goeze, 1782. Lahore, Southwell.

#### REVIEW OF LITERATURE

A number of workers have recorded the incidence of different species of cestodes in dogs from many parts of the world. Saleh and Ahmed (1965) encountered Taenia hydatigena in 23% of 200 dogs examined in Karachi. The same parasite was noted to be present in 21.1% of 61 dogs from rural areas of Omsk region in Russia by Sokolov (1968); in 71% of 140 dogs in Teheran by Mirzayans et al. (1972); in 19 of 44 stray dogs in Lahore, Pakistan by Buscher (1974); 4% of 50 dogs

examined at Utah by Sawyer et al. (1976); in 22 of 66 dogs at Blayney, New South Wales, Australia by Dent and Kelly (1976); in 1% of dogs in Rome by Tassi and Widenhorn (1977); in 2% of dogs in Utah, U.S.A. by Palmieri et al. (1978); in 67.8% of 180 dogs examined in Zaria, Nigeria by Dada et al. (1979); in 72.1%, 77.9% and 66.2% of 330, 145 and 74 dogs respectively examined in the Northern Guinea zone, Sudan zone and Bauchi plateau zone of Nigeria by Dada (1980) in 28.2% of stray dogs in Mansoura City, Egypt by Abo-Shady (1980).

Taenia pisiformis was recorded to be present in 5.5% of dogs in Karachi by Saleh and Ahmed (1965); in 1.6% of 61 dogs from rural areas of Omsk region in Russia by Sokolov (1968); in 11.4% of dogs in Texas by Costa et al. (1971); in 30 out of 102 dogs in North Carolina by Batte et al. (1971); in 33.33% of 66 dogs autopsied by Blayney, New South Wales, Australia by Dent and Kelly (1976); in 8.35% of 100 mongrel dogs examined in Rutherford country, Tennessee, U.S.A. by Panagatos and Dunn (1976); in 4% of 50 dogs examined in Utah, U.S.A. by Sawyer et al. (1976); in 4% of 100 dogs examined in Rome by Tassi and Widenhorn (1977); in 1% of 100 dogs examined in Utah, U.S.A. by Palmieri et al. (1978) and in 11% of 100 dogs examined in Tarrant county, Texas by Stewart et al. (1979).



Taenia ovis was recorded to be present in 1 out of the 1,504 dogs examined in Uruguay by Schantz et al. (1974), in 35% of 180 dogs examined in Zaria, Nigeria by Dada et al. (1979) and in 48.2%, none and 75.1% respectively of the dogs examined in Northern Guinea zone, Sudan zone and Baucal plateau zone of Nigeria by Dada (1980).

Sokolov (1968) recorded 1.6% incidence of Taenia crassiceps infection in 61 dogs in rural area of Irtysh region while Yanchev and Stolchev (1980) recorded occurrence of the parasite in a single dog in Bulgaria.

Sawyer et al. (1976) recorded infection incidence of 26% for Taenia krabbei among 50 dogs examined in Utah while Palmieri et al. (1978) recorded the incidence to be 5% among 100 dogs in the same area.

Taenia serrata was recorded to be present in 1% of dogs examined in Brussels, Belgium by Gerin et al. (1980).

Saleh and Ahmed (1965) had recorded an incidence of 0.5 infection with Taenia multiceps among 200 dogs examined in Karachi and Sokolov (1968) recorded an incidence of 11.4% for the parasite in dogs in rural area of Irtysh region. Mirzay et al. (1972) had recorded that the incidence of T. multiceps is 14.4% among 140 dogs autopsied in Tehran. Canese (1977)

had encountered the parasite in dogs during autopsy in Asuncion, Paraguay.

The incidence of Taenia serialis in dogs was recorded to be 1% among dogs autopsied in Karachi by Saleh and Ahmed (1965) and 6.8% among the 44 pariah dogs autopsied in Texas by Costa et al. (1971).

Saleh and Ahmed (1965) also recorded an incidence of 0.5% infection with Taenia gaigeri among 200 dogs examined in Karachi.

Echinococcus granulosus was recorded to be present in 2 of the 154 dogs examined in Rebus island by Yamashita et al. (1955). Gemnell (1957) found that the infection was prevalent among 25.6% of 524 dogs in New South Wales, Australia examined either by autopsy or by faecal examination and that 5% of city and country town dogs, 21.3% of abattoir dogs, 1% of sheep dogs & 15% of rabbit dogs in New South Wales, Australia carried the infection. The incidence of the parasite in dogs was reported to be 7% in Karachi by Saleh and Ahmed (1965); Girov (1964) recorded incidences of 58.5% and 50% among stray and shepherd dogs respectively. Hissain and Akhtar (1969) reported that 5 of the 20 dogs autopsied in Lahore were infected with the cestode. According to Kannangara & Karunaratne (1970), the incidence was 2% among the 50 dogs autopsied in

Colombo. The incidence of E. granulosus infection in dogs has been recorded to be 0.62% in New Zealand by McCristell (1971); 8% among 140 dogs in Tehran by Mirzayans et al. (1972), 37 out of 179 dogs in Sardinia by Mura and Marcedou (1972) and 18% in and around Shiraz in Iran by Nazarian and Tabatabai (1973). The parasite was noted to be present in 14 out of the 44 stray dogs autopsied by Buscher (1974) in Lahore; in 2 of the 100 dogs examined in Rome by Tassi and Widenhorn (1977). The prevalence rate in 1976 in Skopje, Yugoslavia was 15% according to Lepojev and Velickovski (1979). Dada et al. (1979) encountered E. granulosus in only one out of 180 dogs autopsied in Zaria, Nigeria. While the incidence in the zones of North Guinea, Sudan and Bachui plateau was 1.2%, 6.2% and none, respectively according to Dada (1980). Out of the 109 dogs autopsied in Matera Province, Italy by Puccini & Colella (1979), 9 animals carried E. granulosus with the worm burden as ranging from 11 to 500 in 7 animals and above 500 in the remaining ones; dogs in Mansoura City, Egypt showed an incidence of 1.2%, according to Abo-Shady (1980).

Yamashita et al. (1955) recorded the occurrence of Echinococcus multilocularis among the dogs in Rebun island, Japan. The parasite was also recorded from one of the 20 dogs examined in Lahore by Hussain and Akhtar (1969) which constituted the first occurrence record of the worm for the Indian

sub-continent. Saveliev (1973) encountered the parasite in only one dog out of the 1135 mammals belonging to 15 species examined in Tainujr.

Dipylidium caninum was encountered in 20% of 50 dogs autopsied by Kannangara and Karunaratne (1970) in Colombo. Costa et al. (1971) recorded the parasite in 47.2% of pariah dogs in Texas while Batte et al. (1971) found the parasite in 66 of 102 dogs autopsied at North Carolina. The incidence of the parasite in dogs was recorded to be 18% in Iran by Mirzayans et al. (1972); in one out of 15 dogs in North West Canada by Unruh et al. (1973); in 18 out of 40 dogs in Golan, Brazil by Carneiro et al. (1973); to be 49.2% in 65 dogs examined in Tokyo, Japan by Ohishi et al. (1973); in 22 out of 512 in Ankara by Erturk and Tanzer (1973); in 24 of 44 dogs in Lahore, Pakistan by Buscher (1974); to be 30% among the mongrel dogs in Rutherford County, Tennessee, U.S.A. by Panagatos and Dunn (1976); to be 14% among the 57 dogs from Londrina, Brazil by Chieffi et al. (1976); 2% among the 50 dogs examined in Utah, U.S.A. by Sawyer et al. (1976); 17.5% among the 200 dogs examined at Ipoh, Malaysia by Snanta et al. (1977); 23% among the 100 dogs autopsied in Rome by Tassi and Widenhorn (1977) and only 1% among the 100 dogs examined in Utah, U.S.A. by Palmieri et al. (1978). Infection rates of 32% in 100 dogs was recorded in Tarrant County, Texas

by Stewart et al. (1979), 93.3%, 90.3% and 97.3% among the dogs from the Northern Guinea zone, Sudan zone and Bauchi plateau zone of Nigeria, respectively, by Dada (1980); 34.54% among the dogs in Vratsa district of Bulgaria by Bulgaria by Yanchev and Stoichev (1980); 62.4% of 85 stray dogs in Mansoura City, Egypt by Abo-Shady (1980) and in 6% of 75 dogs autopsied in Brussels, Belgium by Gerin et al. (1980).

Mirzayans et al. (1972) recorded an incidence of 3.5% for Mesocestoides lineatus among 140 dogs screened in Tehran, Iran while an incidence rate of only 1% could be noted among the 100 dogs examined in Rome by Tassi and Widenhorn (1977).

Incidence data on cestode infection in dogs in India is comparatively limited. Malaki (1966) recorded 9 cases of Taenia hydatigena among 61 dogs in Bangalore and Reddy (1967) recorded 12% incidence among dogs in Madras. 31.37% of 51 stray dogs examined by Sahai (1969), 23% of 74 stray dogs in Madhya Pradesh examined by Sahasrabudhe et al. (1969) and 19.4% of 36 dogs examined by Kumar and Sahai in Patna in Bihar carried infection with the parasite. Malaki (1966) recorded one out of the 61 dogs examined in Bangalore as infected with Taenia ovis while Kumar et al. (1972) recorded 56% of incidence for Multiceps multiceps in dogs in Patna, Bihar. Reddy (1967) recorded 8% of infection for Echinococcus granulosus in Madras with intensity ranging from 3 - 534

parasites. Sahai (1969), Pandey (1971) and Khuddus and Rao (1971) and Kumar and Sanai (1972) recorded incidence of 5.88%, 10%, 37.5% and 2.5% for E. granulosus in Barcillely in Uttar Pradesh, in Bihar, in Patna and in Bangalore respectively. The incidence of Dipylidium caninum was reported to be 47% in dogs in Madhya Pradesh and 25% in dogs in Bihar by Sahasrabudhe et al. (1969) and Kumar and Sahai (1972) respectively. Pythal (1974) observed that natural incidence of taeniid tapeworm was nil among the 5 dogs examined by him.

Banerjee et al. (1974) have recorded Mesocestoides tenuis in a pet dog which was a new record for India. Pal et al. (1981) have recorded a spirometrid tapeworm from a mongrel dog in Darjeeling.

Incidence of cestode infections in dogs, as determined by examination of faecal samples, has been reported from different parts of the world, as follows:

Taenia hydatigena infection was recorded by Shepelev (1953) in 16.3% of stray dogs and 4.1% of watch working dogs, in Ivanovo region of U.S.S.R.; by Forbes (1961) in 10.5% of dogs in the North Islands of New Zealand; by Mituch (1968) in 1.6% of 63 mongrels and none of 214 pure-bred dogs in Slovakia; by Jackson and Arundel (1971) in 12% of farm dogs in the State of Victoria, Australia; by Gregory (1973) in 11.6% of 16,214 dogs in Tasmania; by Chaneet and White (1976)

in 15.1% of dogs in Albany area of Western Australia; by Schawalder (1976) in 6.6% of 212 dogs in Bern, Switzerland; by Dent and Kelly (1976) in 11.2% of dogs in New South Wales, Australia; by Williams (1976) in 147 of 320 dogs in Dyfed, South Wales, U.K.; by Schantz et al. (1977) in 45.5% of 420 dogs in Arizona and New Mexico, U.S.A.; by Davies and Nicholls (1977) in 15 of 110 dogs in Goodradigbee Shire, New South Wales, Australia; by Karasev et al. (1977) in 24 of 313 dogs in Vitebsk, Belorussian S S R; by Oberg et al. (1979) in 12 out of 75 dogs in Valdivia, Chile; by Arru and Vieddu (1979) in 9.17% of dogs in Sardinia and by Edwards et al. (1979) in 11.3% of 115 dogs in Wales, U.K. Hackett and Walters (1980) has reported 18% reduction in the prevalence of T. hydatigena in 508 farm dogs in Powys, Wales.

Taenia pisiformis infection was recorded to be 1.9% among the dogs in the North Island of New Zealand by Forbes (1961); 36.2% and 16.8% respectively, in 63 mongrels and 214 pure-bred dogs in Slovakia, U.S.S.R. by Mitou (1968); 35% in 792 dogs in the State of Victoria, Australia by Jackson and Arundel (1971) and 26.2% in dogs in Tasmania by Gregory (1973). The infection was reported to be 15.1% among dogs in Albany area of Western Australia by Chaneeet and White (1970); 5.2% in 212 dogs in Bern, Switzerland by Schawalder (1970) and 22.3% in dogs in Blayney, New South Wales, Australia by

Dent and Kelly (1976). The infection was also encountered among 50 out of the 351 dogs in Dyfed, South Wales, U.K., by Williams (1976) in 21% of the dogs in Arizona and New Mexico, U.S.A. by Schantz et al. (1977); in 10 out of 110 dogs examined in Goodradigbee-shire, New South Wales, Australia by Davies and Nicholas (1977); in 5 out of 318 dogs in Vitebsk, Belorussian S S R, by Karasev et al. (1977); in 35.37% of dogs in Sardima, Chile, by Arru and Nleddu (1979); in 6.6% of dogs in Wales, U.K. by Edwards et al. (1979) and in 10% of dogs in Powys, Wales by Hackett and Walters (1980).

Multiceps multiceps infection in dogs was recorded to be 3.1% and none respectively, in mongrels and pure-bred dogs in Slovakia, U.S.S.R. by Mituch (1968). The infection was encountered to be prevalent in 40 out of the 351 dogs in Dyfed, South Wales, U.K. by Williams (1976); in 3.5% of the 115 dogs in Wales, U.K. by Edwards et al. (1979) and in 10% of the 508 dogs in Powys, Wales by Hackett and Walters (1980)

Multiceps serialis infection in dogs was recorded by Forbes (1961) to be 0.09% in North Island of New Zealand; by Jackson and Arundel (1971) to be 2.5% in dogs in the State of Victoria, Australia; by Gregory (1973) to be 1.0% in dogs in Tasmania; by Chaneeet and White (1976) to be 2.3% in dogs in Albany area of Western Australia; by Schantz et al. (1977)



to be 11.9% in dogs in Navajo Reservation in Arizona and New Mexico, U.S.A., and by Davies and Nicholas (1977) to be present in 19 out of the 110 dogs examined in Goodradigbeeshire, New South Wales, Australia.

The incidence of Echinococcus granulosus in dogs was recorded to be 3.9% in North Island of New Zealand by Forbes (1961); 7.9% and 0.92% in 63 mongrels and 214 pure-bred dogs, respectively in Slovakia by Mituch (1968); 17.83% in dogs in the province of Saragossa, Spain, by Gomez and Vivas (1969) and 3% in dogs in the State of Victoria, Australia by Jackson and Arundel (1971). The infection was noted in 53 out of the 263 dogs examined in Huancayo Province, Peru by Leguia and Guerrero (1972); in 1.1% of dogs in Tasmania by Gregory (1973) in 2 out of 864 dog samples examined in Hamburg, West Germany by Hagedorn (1974); in 3.9% of dog in different areas of Cairo, Egypt by Moch et. al. (1974); in 33 dogs out of 571 in various area of Apulia, Italy by Puccino et al. (1975) in 0.7% of dogs in Albany area of Western Australia, by Chaneeet and White (1976) in 5.2% dogs in Berlin, Switzerland by Schawalder (1976); in 50 out of 351 dogs in Dyfed, South Wales, U.K. by Williams (1976) and in 4.1% of dogs in New South Wales, Australia by Dent and Kelly (1976). The infection has been reported to have fluctuated from 12.7% to 0.38% in Tasmania, during 1970 to 1975, by Gregory (1977). The incidence has been reported to be 0.7% in 254 dogs in Blayneyshire, New South Wales by Dent and

Howkin (1978); 31.2% in urban and rural areas of Chile by Sims and Sanchez (1979); 1.82% and 23.9% among stray dogs and sheep dogs, respectively, in Sardinia by Arru and Nueddu (1979); and 0.8% in Wales, U.K. by Edwards et al. (1979). The infection was noted among 7 out of the 31 dogs from a rural area of Valdivia, Chile by Ernst et al. (1980). The incidence was recorded to be 25.2% in dogs in Powys, mid-Wales, U.K. by Walters and Clarkson (1980); 13%, 26% and 23%, respectively, in January, May and October, in Powys, Wales by Hackett and Walters (1980); and 62.5% among the dogs in Bangladesh by Islam (1980).

The incidence of Dipylidium caninum infection was 23.1% and 24.8% in mongrels and pure-bred dogs respectively, in Slovakia, U.S.S.R. as recorded by Mituch (1968). The incidence was recorded to be 11.42% in Santiago, Chile by Alcaino and Tagle (1970). The infection occurred in 15 out of the 594 dogs examined in Paris, France by Waitely and Pitols (1970) in 17% of the dogs in the State of Victoria, Australia, by Jackson and Arundel (1971); in 3% of the dogs in Iran, by Mirzayans et al. (1972); in 2% of the dogs in Parana, Brazil by Fernandes et al. (1973); in 9.8% of dogs in Tasmania by Gregory (1973); in one out of the 260 dogs in Milan, Italy, by Genchi et al. (1974); in 67.5% of dogs in Sydney, Australia, by Kelly (1975); in 16.4% of the dogs in Albany area of

Western Australia, by Chanest and White (1976); in 13.6% of the dogs in Blayney, New South Wales, Australia, by Dent and Kelly (1976); in 14 of the 31 dogs in Dyfed, South Wales, U.K., by Williams (1976); in 5 out of the 313 dogs in Vitebsk, Belorussian SSR; by Karasev et al. (1977); in 6.7% of the dogs in Blayney, by Dent and Howkin (1978); in 2.5% of the dogs in Forlì, Italy, by Bazzocchi and Ganestri-Trotti (1979) and in 26 out of 75 dogs in Valdivia, Chile, by Oberg et al. (1979). The infection was also noted among 67.5% of dogs in Zaria, Nigeria, by Dada and Belino (1979); 74.67% of the dogs in Sardinia, by Arru and Nieddu (1979); in 8.9% of the dogs in Wales, U.K. by Edwards et al. (1979); in 3% of the dogs in the Province of Forlì, Italy by Bazzocchi and Ganestri-Trotti (1980); and in 10% of the farm dogs in Powys, Wales by Hackett and Walters (1980).

Mesocestoides lineatus infection in dogs was recorded in 3.1 and 6.9% of mongrels and pure-bred dogs, respectively, in Slovakia, by Mituch (1968); in 1% of dogs in Iran by Mirzayans et al. (1972); in a single dog in Michigan, U.S.A. by Williams et al. (1975); and in 0.9% of the dogs in Bern, Switzerland by Schawaldor (1976); and in 8.3% of 358 dogs examined in Sardinia by Arru and Nieddu (1979).

Spirometra erinacei infection in dogs was reported from a single dog out of the 792 dogs examined in the State of

Victoria, Australia, by Jackson and Arundel (1971); in 3 out of the 16, 214 dogs in Tasmania by Gregory (1975) and in 3% out of 236 dogs in the basin of Toda river, Nagoya by Yoshida and Yoshida (1973).

Schawwalder (1976) has recorded Diphyllobothrium latum infection in 1.4% of the 212 dogs examined in Bern, Switzerland.

The incidence of cestode infections in dogs in India, recorded on the basis of examination of faecal samples is, however, scanty. Reddy and Navaian (1968) reported an incidence rate of 33.3% for Echinococcus granulosus among the dogs in Kurnool while Dhar et al. (1968) recorded infection with the above parasite in 1.4% of 144 dogs examined in Delhi. Prakash et al. (1969) reported that incidence of E. granulosus infection among dogs in Delhi was 4.6%. According to Hegde et al. (1974) 10% of the dogs in Bangalore carried E. granulosus infection. Mohanlal (1982) has reported that Dipylidium caninum ova were present in 2 out of the 62 faecal samples of dogs examined, incidence being 4.3% in animals of the age group above 3 months.

## *Results*

---

## RESULTS

During the present studies, autopsy screening of 88 stray dogs falling under different age group categories as those upto 6 months, to those above 5 years, revealed the occurrence of the following 4 strobilate cestodes, the age group incidence and intensity of infection of each of which is presented in tables I to V.

1. Dipylidium caninum
2. Joyeuxiella pasqualei
3. Echinococcus granulosus
4. Taenia hydatigena.

Joyeuxiella pasqualei (Diamare, 1893) has been recorded from the dog for the first time in India during the present studies, constituting a new host record for the parasite in the country.

Of the 88 dogs examined 40 belonged to the age group of upto 6 months out of which 20 (50%) harboured Dipylidium caninum and one (2.5%) Joyeuxiella pasqualei; out of the 11 animals of the age group of above 6 months upto one year, 7 (63.64%) harboured Dipylidium caninum and one (9.09%) harboured Joyeuxiella pasqualei; none of the 4 animals of the age group of above one year upto 2 year carried any cestodes. While 10 out of the 23 animals (43.48%) of the age group of above 2 years upto 5 years carried Dipylidium caninum, 2

(8.7%) Joyeuxiella pasqualei, 2 (8.7%) Echinococcus granulosus and one (4.3%) Taenia hydatigena. The infection with cestodes in animals of the age group of above 5 years was to the tune of 7 of 10 (70%) in the case of Dipylidium caninum, one (10%) in the case of Taenia hydatigena and 3 (30%) in the case of Echinococcus granulosus. Altogether, 44 dogs (50%) carried Dipylidium caninum infection; 4 (4.55%) Joyeuxiella pasqualei infection, 2 (2.27%) Taenia hydatigena and 5 (5.68%) Echinococcus granulosus.

Out of the 49 dogs found to be positive for cestode infection, 2 (4.03%) carried mixed infection with Dipylidium caninum and Joyeuxiella pasqualei; one (2.04%) carried mixed infection with Dipylidium caninum and Taenia hydatigena; 2 (4.08%) carried mixed infection with Dipylidium caninum and Echinococcus granulosus; one (2.04%) carried mixed infection with E. granulosus and Taenia hydatigena.

The incidence of monospecific infection was 39 (79.59%) for Dipylidium caninum; 2 (4.08%) Joyeuxiella pasqualei; 2 (4.08%) Echinococcus granulosus and none with Taenia hydatigena.

Among the 16 male animals of the age group of upto 6 months 6 (37.5%) harboured cestode infections while out of the 24 female of the same age group 14 (58.33%) were positive for cestode infection. The sex wise incidence of Dipylidium

caninum cestodes was 2 out of 6 (33.33%) among the females of above 6 months upto 1 year and all of the 5 (100%) male animals of the same group; 7 out of the 14 (50%) among the males and 3 out of 9 (33.33%) among the females of the age group of above 2 years upto 5 years as well as 6 out of the 7 (85.71%) among the males and one out of 3 (33.33%) among the females of the age group of above 5 years.

Joyeuxiella pasqualei occurred in only 1 (6.25%) out of 16 males, 1 (16.67%) of the 6 females in addition to 1 each of the 14 males and 9 females in the age group categories first, second and fourth detailed in the table. Showing very sporadic incidence in comparison to that of Dipylidium caninum.

The incidence of Taenia hydatigena was restricted to only 1 (7.14%) out of 14 male dogs, and 1 (33.33%) out of 3 female dogs of the age group categories 4 and 5 thereby denoting a much lesser incidence for the parasite. The incidence of Echinococcus granulosus, encountered only among the age group categories 4 and 5 was respectively 1, out of 14 (7.14%) among the males and one out of 9 (11.11%) among the females of the first group and 2 out of the 7 (28.57%) among the males, and 1 out of 3 (33.33%) among females of the second group.

The intensity of infection with Dipylidid cestodes is



summarized in Table III. The intensity varied from 2 - 30, 5 - 34 and 3 - 45 for juvenile, adult, and fertilized cestodes respectively in the case of male dogs of the age group of upto 6 months, corresponding figures being 2 - 10, 6 - 25 and 4 - 65 among the females of the same age group; 1 - 3, 1 - 8, and 1 - 9 among the males and only 3 - 4 fertilised cestodes in 2 female animals in the age group of above 6 months upto 1 year; 2 - 5, 2 - 9 and 2 - 20 among the males, with females having intensity ranging from 2 - 4, 2 - 13 and a sole case of 38 parasites respectively in the age group of above 2 years upto 5 years; the juvenile, adult and fertilised cestodes among the male animals of the final age group being 2, 1 - 12, and 1 - 16 for male dogs and nil, 2 and 5 for the only female dog. The intensity of infection with Joyeuxiella pasqualei of which only fertilised specimen were encountered in two cases and juvenile, adult as well as fertilised specimen were encountered in the remaining case varied from 2 - 6, in the case of former and was 5, 1 - 6 and 2 - 7, juvenile, adult and fertilised specimens respectively in the case of the latter.

Intensity of infection with Taenia hydatigena was 2 fertilised specimen in the single incidence among the animals of age group of above 2 years upto 5 years and one incidence of fertilised specimen among the final age category.

In the case of Echinococcus granulosus only adult or fertilized specimen were encountered, the intensity of which was 14 and 80 respectively for the former, 26 and 300 for the latter among the animals of the age group category 4, while the animals of the age group category 5 had the intensity ranging from 10 to 160 and 26 to 840 for the adult and fertilized specimen respectively.

A total 119 dogs were screened for cestode infection by examination of faecal samples, of which 17 out of the 52 animals of the age group of upto 6 months which were under observation in cages during the study revealed the presence of gravid segments of D. caninum, indicating the fact that infection with the parasite could be detected by faecal examination only in cases where the animals are under observation and the faecal samples are subjected to detailed examination immediately on discharge. The only other case of detection of cestode infection of dog by the presence of proglottids in the faecal material related to that of single case Dipyllobothrium latum infection, in which a senile piece of strobila was got expelled on an occasion. A single incidence each of detection of cestode infection from the presence of ova of the parasite existed in the case of Dipylidium caninum and Dipyllobothrium latum and Taeniid species; the latter being impossible to be assigned to a particular parasite

because of the overlapping ranges of a number of morphological parameters with regard to the species of the family Taeniidae. The above observation prove beyond doubt that examination of faecal sample for cestode infection gave only unreliable information speculation based on which will be fallacies rather than feasible indications.

The genus Diphyllobothrium Cobbold, 1958.

The genus Diphyllobothrium was established with Diphyllobothrium stemmacephalum as the type species by Cobbold (1958). Luhe (1899) changed the name of the genus to Dibothriocephalus, making Dibothriocephalus latus as the type species. But later, in the year 1910, Luhe re-established the genus Diphyllobothrium.

According to the available literature, the following stand as valid species of the genus at present:

D. alascense Rausch and Williamson, 1958.

D. cameroni Rausch, 1969.

D. cordatum (Leuckart, 1863).

D. dalliae Rausch, 1950.

D. discipiens

D. didelphydis

D. dendriticum (Nitzsch, 1824).

D. elegans (Krabbe, 1865).

- D. fuhrmanni
- D. fuscum
- D. glaciale (Cholodkowsky, 1915).
- D. gondo
- D. granata
- D. hians (Diesing, 1850).
- D. krotovi
- D. lanceolatum (Kraboe, 1865).
- D. laruei
- D. lashleyi (Leiper and Atkinson, 1914).
- D. latum (Linnaeus, 1758).
- D. minus (Cholodkowsky, 1916).
- D. mobile (Rennie and Reid, 1912).
- D. masoni
- D. norvegicum
- D. pacificum (Nybelin, 1931).
- D. quadratum (von Linstow, 1892).
- D. railleti
- D. romeri (Zschokke, 1903).
- D. scoticum (Rennie and Reid, 1912).
- D. subtile
- D. theileri
- D. trinatis
- D. ventropapillatum Delianure, 1955.

D. wilsoni (Shipley, 1907).

D. ursi Rausch, 1954.

Rausch and Hilliard (1970) are of the view that many species of the genus Diphylobothrium may occur naturally in both terrestrial and marine mammals. According to them, D. latum is the most common species of the genus encountered in dogs all over the world.

A single specimen referable to D. latum was encountered during the present investigation. (Plate 1<sup>x</sup> )

The worm was white to ivory coloured and measured 150 cm in length. It was devoid of scolex and carried 184 proglottids.

The neck was attenuate, unsegmented and measured 9 mm in length. About four fifth of the strobila consisted of maturing as well as mature proglottids. The mature proglottids were somewhat broader than long measuring 8 x 20 mm respectively with regard to the parameters and were completely filled with the structures of the male and female genital complexes. The testes were minute multiple follicles numbering from 700 to 800 per segment and situated in both the lateral fields in the dorsal plane of the body. The vasa efferentia united mesially in front of the ootype to form the vas deferens which then proceeded anteriorly as a convoluted tube extending to the upper border of the genital atrium.

Near its terminus, it carried a seminal vesicle and muscular cirrus organ. The ovary was situated ventrally in the posterior third of the proglottid and carried a pair of symmetrical lobes. Between the two lobes of the ovary was situated the ootype, surrounded by the Mehlis gland. The vagina extended forward from the ootype and opened externally immediately behind the male genital pore. The vagina received near the proximal end the oviduct as well as the common vitelline gland duct, that collects the vitelline material from the numerous vitelline follicles situated ventral to the testes, in the lateral fields. The uterus, arising from the ootype, convoluted to form a rosette-shaped structure and opened out at the uterine pore, situated ventrally, at a little distance to the side, behind the vaginal pore. The convoluted mass of the uterus revealed an inner as well as an outer portion both of which were clearly discernible.

The eggs were trematode like in appearance, being oval and operculated and measured 70 x 50 microns. The eggs contained only unembryonated germinal mass in the process of cell differentiation.

The genus Taenia Linnaeus, 1758.

The genus Taenia was first established by Karl Linnaeus in 1758 with the human parasite Taenia solium as the type species. According to the available literature, the following

constitute the valid species of the genus encountered in dogs:

T. crassiceps (Zeder, 1800)

T. hydatigena (Pallas, 1766)

T. kraboei (Momez, 1879)

T. ovis (Cobbold, 1869)

T. plisiformis (Bloch, 1780)

During the present investigation, specimens referable to T. hydatigena (Plate I & II) were encountered in two dogs.

The worms were stout with well-defined scolex and were milky-white in colour. They measured 84 to 90 cm in length. The scolex was globoid and measured 0.980 mm in diameter. It carried four round muscular, cup-shaped suckers, measuring 0.520 x 0.360 mm in diameter, each carrying anteriorly directed adhesive areas. Anteriorly the scolex carried a muscular, protrusible rostellum, which was dome-shaped and bearing 26 to 44 hooks, in two rows of an inner smaller ones and an outer larger ones, with alternating dispositions. The large hooks and the small hooks respectively measured 170 - 220  $\mu$  and 110 - 160  $\mu$ .

The strobila was long and broad and contained 98 to 106 segments. The posterior margin of each segment overlapped the anterior margin of the succeeding one. Segments in the gravid part of the strobila exhibited tendency for a median

longitudinal furrow on the dorsal as well as ventral surfaces with indication to terminate posteriorly in a notch. The proglottides carried single genitalia and the genital pores which were irregularly alternating were situated near the middle of the lateral margin of each segment.

The male genitalia consisted of 600 - 700 testes distributed evenly over the dorsal surface of the segment, not overlapping the ovarian and vitelline areas. Seminal vesicle was absent. The cirrus sac, which was cylindrical, measured 450 x 130  $\mu$ m.

The ovary was bilobed, each lobe being almost circular and the sporal wing distinctly larger than the poral. The vitelline gland was large lying transversely behind the ovary. The conspicuous shell gland was situated between the ovary and the vitelline gland. The uterus had a median longitudinal stem and 5 to 10 stout, lateral branches on either side, each showing evidences of sacculations towards apices.

The eggs were almost round, measuring 0.008 x 0.064  $\mu$ m with the characteristic radially striated embryophore enclosing the hexacanth embryo, and surrounded by an albuminous coat. The embryo measured 0.026 x 0.034  $\mu$ m with hooks, 94 to 120 microns in length.



The genus Echinococcus Rudolphi, 1801.

The genus Echinococcus was created by Rudolphi in 1801 for a larva described by Goeze (1782) from the liver of a sheep and was named Taenia visceralis socialis granulosa. The important species of the genus, encountered in dogs, are the following:

E. granulosis (Batsch, 1786) Rudolphi, 1805.

E. multilocularis Leuckart, 1863.

E. oligarthrus Diesing, 1863.

During the present investigation, cestodes referable to E. granulosis were encountered in certain dogs (Plate III<sup>XIV</sup>).

The worms were minute measuring 3 to 6 mm in length and having only 3 or 4 segments. The scolex was pyriform and about 300 microns in diameter, provided with 4 suckers varying in measurements from about 0.013 mm and armed with 28 - 50 hook borne on the apical procrusible rostellum. The neck which is attenuated, measured 0.2 to 0.3 mm in length. In worms having 3 segments, one of the segments was immature, one mature and one gravid, while 2 immature segments occurred in worms carrying 4 proglottides. In all cases the terminal proglottid was broadest and longest and followed in size by the mature one.

The female genital organ was situated in the posterior

third of the segments. The ovary consisted of 2 oval, compact masses joined by a narrow commissure. The vitellarium was behind the centre of the ovary, near the posterior margin of each segment. Menlis gland was situated between the ovary and the vitellarium.

The male genitalia comprised 32 to 40 testes measuring 0.02 to 0.03 mm in size. The genital pore always opened in the posterior half of the segment. The uterus extended the entire length of the mature segments and carried a variable number of lateral branches with terminal outpocketings, resembling a loosely twisted coil in the terminal segment.

The eggs were spherical and measured 0.032 to 0.036 x 0.025 to 0.03 mm, with an onchosphere each, 0.016 x 0.020 mm in size.

The Genus Dipylidium, Leuckart, 1863.

Leuckert (1865) established the genus with Dipylidium caninum (Linnaeus, 1758) as the type species. Lopez - Neyra (1928) and Venard (1938) have reviewed the genus. According to the latter, the important species under the genus are D. caninum, D. otocyonis and D. buencaninoi. During the present investigation, cestodes referable to D. caninum (Wittenberg, 1952) were encountered quite frequently (Plate <sup>V4V</sup>).

The worms measured 240 to 520 mm in length and 2 to 3.2 mm in maximum width with the strobila having a chain of elliptical proglottides. The scolex was small and rhomboidal, measuring 0.2 to 0.25 mm in transverse diameter. It carried four deeply cupped, oval suckers and a median apical club-shaped rostellum, capable of almost full protrusion or complete invagination into the scolex. The rostellum was armed with two to four circlets of hooks, each with short curved arm and large round base. The anterior hooks were the largest measuring 0.012 to 0.015 mm and the posterior ones the smallest, measuring 0.005 to 0.007 mm. The neck was short and slender. The immature proglottids were broader than longer in the proximal areas and squarish in distal portions. The mature and gravid segments were typically pumpkin seed shaped. Each mature segment was provided with a double set of reproductive organs, with the genital atrium on each lateral margin. The number of testes varied from 100 to 120. The maximum width of the segment which was in the middle, was 3.2 mm. Receptacula seminalis was lacking. The gravid proglottids were filled with 160 to 180 egg packets, each with 8 - 16 eggs enclosed in an embryonic membrane. The eggs were spherical and measured 0.036 x 0.048 mm.

The genus Joyeuxiella Funrmann, 1935.

(*Joyeuxia* Lopez - Neyra, 1927 pre-occupied)

The generic name *Joyeuxia* which was proposed by Lopez-Neyra, 1927 was declared to be inadmissible by Fuhrmann (1935) who proposed the name *Joyeuxiella* as a nomen novum for the taxa. Among the members of the genus, *J. pasqualei* (Diamaere, 1893) is an important cestode, being encountered frequently in cats. During the present investigation, *J. pasqualei* was encountered in dog (Plate <sup>VII</sup> VIII).

The length of the strobila ranged from 20 - 30 cm with maximum width of 2 mm near the middle region. The rostellum carried a larger number of 14 - 16 crowns of hooks in comparison to the 2 - 4 crowns of *Dipylidium caninum*. The shape of the segments appeared to be almost half-hexagonal, with the anterior corners of the hexagon lying between the first third and first half and representing a prominent projection each on the lateral margin, carrying the genital atrium. The mature segments carried, each 46 to 50 testes. The gravid segments carried single eggs per egg capsules, each measuring 0.033 x 0.048 mm in diameter.

# *Photographs*

---

Plate I



Fig 1



Fig 2

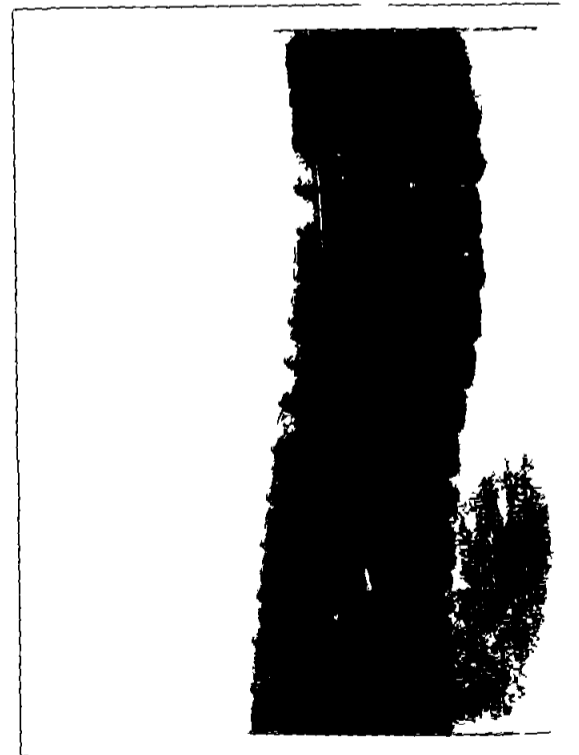


Fig 3

Plate 11



Fig 1



Fig 2

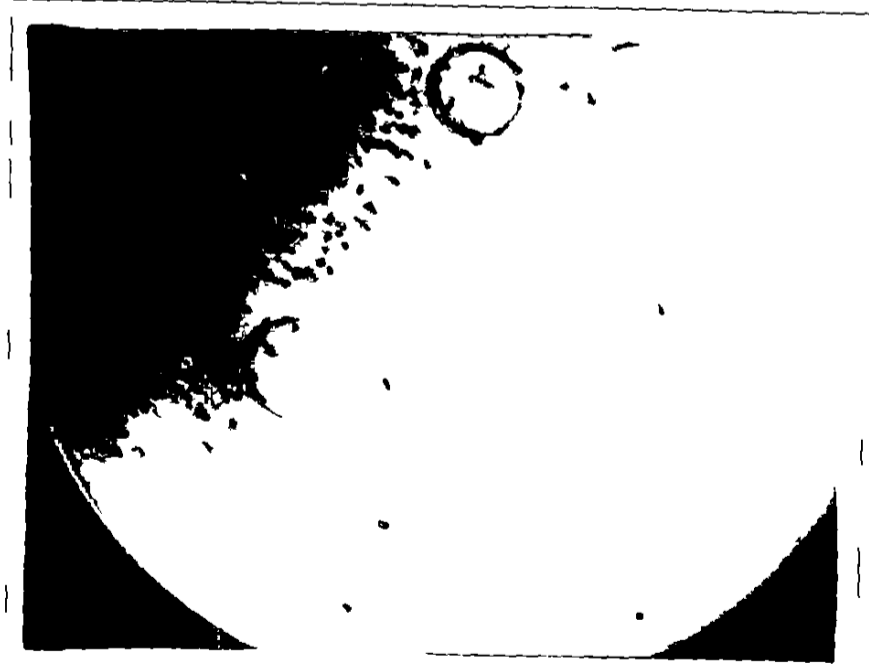


Fig 3

Plate III

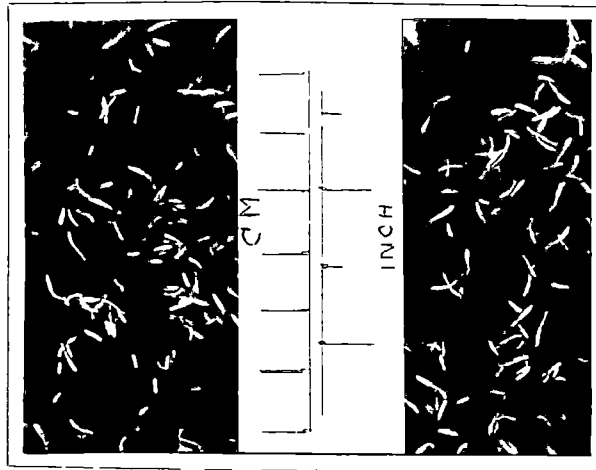


Fig 1

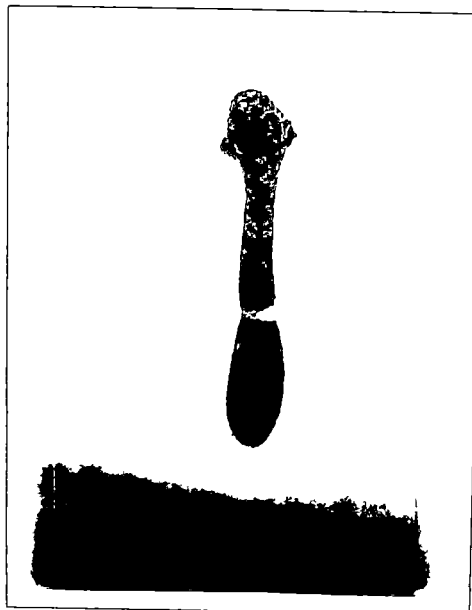


Fig 2



Plate IV

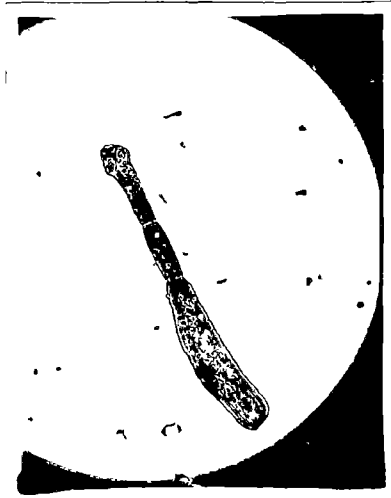


Fig 1

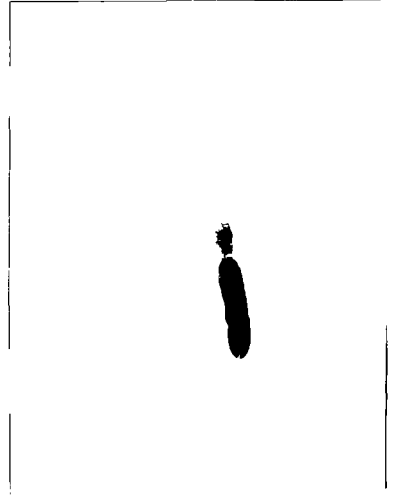


Fig 2



Fig 3

Plate V

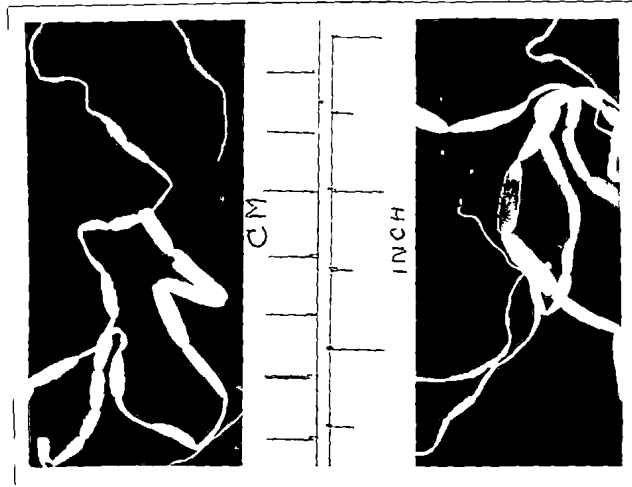


Fig 1



Fig 2

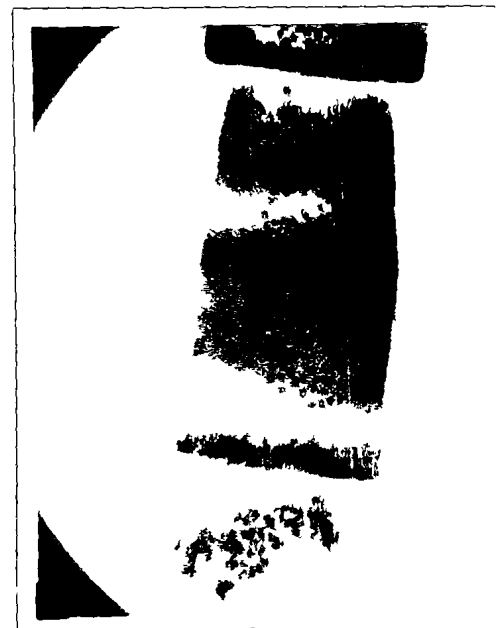


Fig 3

Plate VI



Fig 1

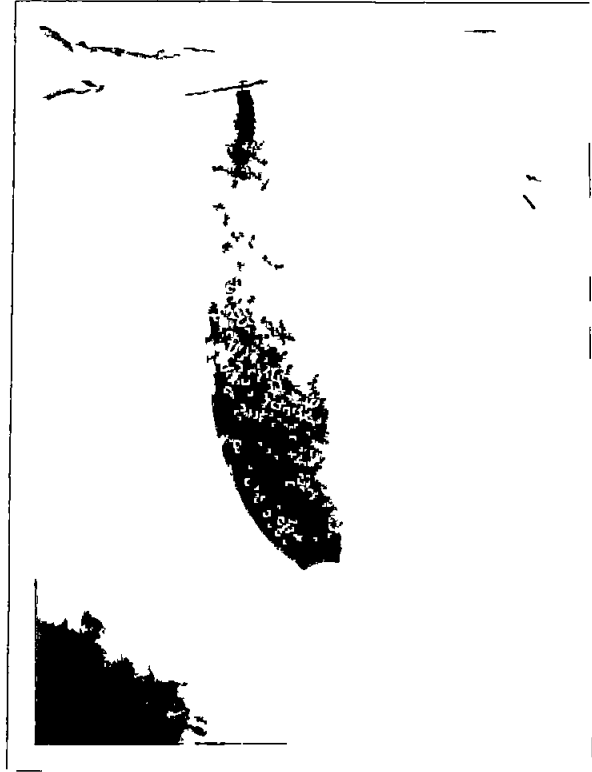


Fig 2

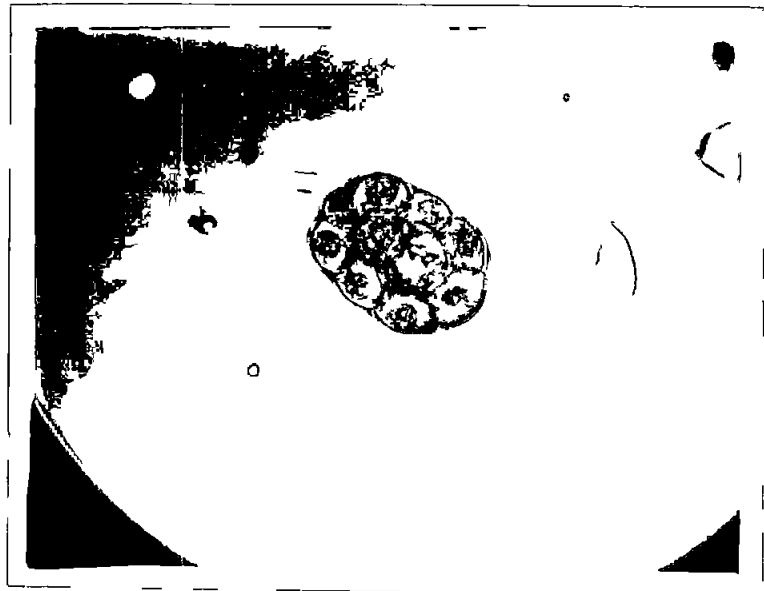


Fig 3

Plate VII



Fig 1



Fig 2



Fig 3

Plate VIII



Fig 1



Fig 2



Fig 3

Plate IX

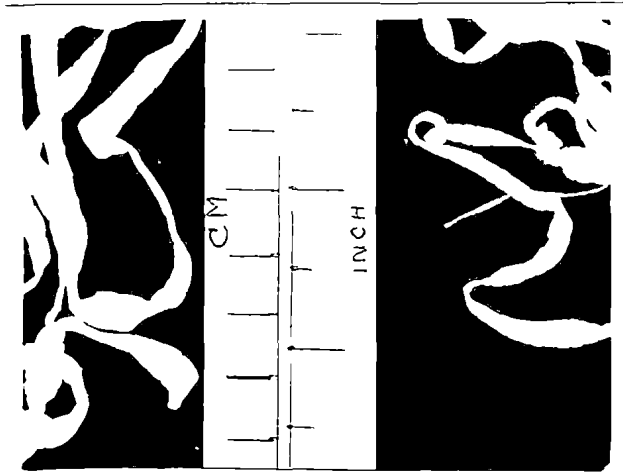


Fig 1



Fig 2

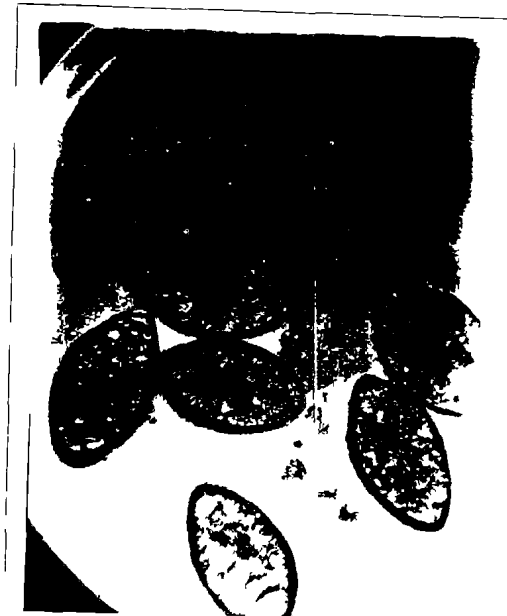


Fig 3

Plate X

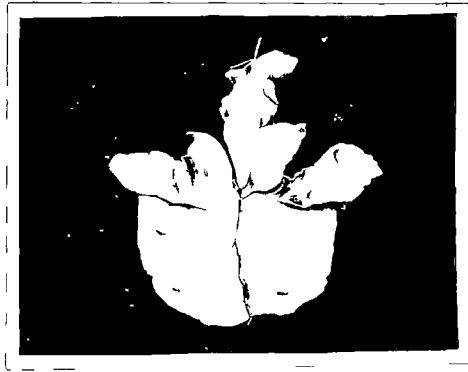
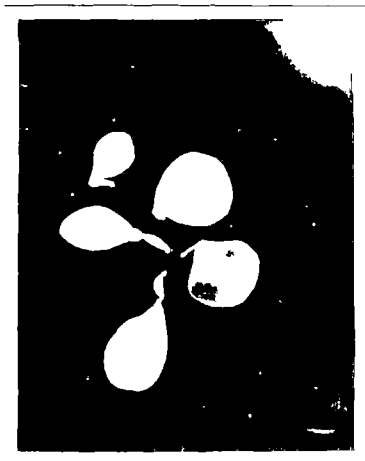


Fig 1



Fig 2



# *Treatment of Cestode Infection Review*

---



## TREATMENT OF CESTODE INFECTION

Anthelmintic treatment of cestode infections constitute an important part of the control programmes aimed at the eradication of the parasites. The older practices of assessing the efficacy of anthelmintic on the basis of the apparent clinical cure as evinced by the discharge of portions of the strobila as well as the absence of appearance of gravid segments and/or cestode eggs in the faeces of the animal consequent to the treatment has been proven to be less reliable, because of the fact that the retention of the scolex defeats the very purpose of the treatment. Since effective treatment of cestode infections presupposes the removal of the scolex as well and since the best evidence of such a treatment is the elimination of the scolex as determined by an autopsy screening, controlled treatment trials with anthelmintics carry more relevance in cestode infection. Mosky and Harewood (1941) evolved the controlled test involving a comparison of worm numbers between treated and untreated group of animals. In the present investigation the method adopted by Mosky and Harewood (loc. cit.) was employed with regard to infection with Taenia hydatigena as well as with Echinococcus granulosus. In infection with Dipylidium caninum, which could not be artificially set up because of the limitation involving the rearing of the intermediate host, controlled trials were not carried out and

only clinical trials based on the treatment and post treatment data pertaining to the discharge of segment or ova alone was carried out.

The controlled trials undertaken against Taenia hydatigena involved nine compounds namely, Albendazole, Amodiaquin, Fenbendazole, Hexachlorophene, Mebandazole, Naclosamide, Oxytetracycline, Praziquantel and Fenbendazole whereas similar trials against Echinococcus granulosus involved the sole use of fenbendazole only. The clinical trials carried out against Dipylidium caninum involved all the nine drugs used in the controlled trials against Taenia hydatigena infection.

#### REVIEW OF LITERATURE

Anticestodal activity have been reported for a number of drugs by various authors.

Albendazole (methyl (5 - (propyl thio) - 1H - benzimidazole - 2 - Y1) carbamate) is an anthelmintic developed by Smyth Kline Animal Health Products, Pennsylvania. The preliminary trial by Theodorides et al. (1976) suggested that it is active against cestodes of domestic animals like sheep and cattle at the dose rate of 10 mg/kg body weight, being cent per cent effective against Moniezia sp. in sheep

at 10 mg/kg body weight. Georgi (1980) used a multiple dosage of 25 mg/kg for 3 - 5 days and found the drug to be active against Taenia species infection in dogs and also reported that the activity of the drug is slight against Dipylidium species in dogs. According to Todd (1978), the drug was effective against Mesocestoides corti infection in pups at multiple doses of 50 mg/kg body weight twice daily for 2 days or at single dose of 100 mg/kg body weight, as ascertained by autopsy screening after 3 days.

Fenbendazole (5 (phenylthio)-2-benzimidazole carbamic acid and methyl ester), the anthelmintic developed as Panacur by Hoechst, was claimed to be of value against gastrointestinal nematodes and lung worms as well as tape worms in sheep and goat. Gemmellet al. (1976) noticed that the drug reduced worm burden with Taenia hydatigena in experimentally infected dogs at a single dose of either 20 mg/kg or 80 mg/kg body weight.

Hexachlorophene (2-2'-methylene bis (5,4,6 - trichlorophenol), the drug marketed as Distodia by Pfizer Ltd., India was stated to have limited use as anticestodal drug also in dogs. According to Leushin (1970), the drug was found to be effective and with lower toxicity at dosage of 15 mg/kg body weight in dogs experimentally infected with Leishino-coccus and Multiceps species. Demidov and Aminznanov (1975)

obtained 83.9% to 100% efficacy for the drug at 15 mg/kg body weight against experimental as well as natural Taenia hydatigena, Multiceps and Echinococcus infections in dogs. Aminzhanov (1977) obtained 100% efficacy with a combination of phenasal at 50 mg/kg body weight and Hexachlorophene at 100 mg/kg body weight in food granules against experimental as well as natural echinococcosis and natural infections with Taenia hydatigena as well as Multiceps in dogs.

Mebendazole (methyl 5 - benzoyl - 2 - benzimidazole carbamate), marketed as Wormin by Cadila Ltd. is claimed to be effective against adult as well as larval cestode infections. Vanparijs and Thienpont (1973) using a dosage of 100 mg mebendazole twice daily for 5 days, obtained 100% efficacy in 37.5% of dogs infected with D. caninum, 80% of dogs infected with Taenia pisiformis and 77.7% of dogs infected with T. hydatigena. Gemmell et al. (1975) obtained 100% efficacy with mebendazole against Echinococcus at a single dose of 160 mg/kg body weight as well as at a double dose of 20 mg/kg body weight at 2 day intervals. The above authors also found that the drug was 100% effective at single doses of 20 or 40 mg per kg body weight against Taenia hydatigena. Gemmell et al. (1977) reported that the drug at 20 - 160 mg/kg body weight could not fully remove Echinococcus granulosus infection in dogs, while it could clear

Taenia hydatigena infection at the dose rate of 40 mg/kg body weight. Gurrero et al. (1981) recorded 100% efficacy for the drug at a multiple dosage of 22 mg/kg body weight for 5 days and only 93.8% efficacy at the same dosage for 3 days, in natural infections of dogs with Taenia pisiformis. Siya and Tripathy (1981) recorded 100% efficacy for the drug against T. hydatigena infection in dogs at the dosage of 100 mg/kg body weight for 3 consecutive days.

Niclosamide (2'5 - dichloro - 4' nitrosalicylanilide), marketed as Mansoni1 by Bayer, Lever Kusen, Germany has been claimed to be effective against cestodiasis in animals. Good results were obtained with the drug against Dipylidium caninum at dose of 100 mg/kg body weight by Kurelec and Rajavec (1961); with 2 doses of 125 - 150 mg/kg body weight at interval of 12 hrs. by Teichmann and Grunbaum (1964); with doses of 110, 157 or 220 mg/kg body weight by Poole et al. (1971); at 160 mg/kg body weight by Neuman and Zavadil (1971); at 300 mg/kg body weight by Guralp and Tigin (1966). The efficacy of the drug against Taenia hydatigena has been authenticated by Forbes (1963) at 100 mg/kg as well as at 150 mg/kg body weight; by Guralp and Tigin (1966) at 300 mg/kg body weight; by Ibragimov (1976) at 300 mg/kg body weight; by Matchanov et al. (1977) at 250 mg,



kg body weight and by Gemmel et al. (1977) at 32 or 62 mg/kg body weight. The drug was found to be effective against T. pisiformis by Neumann and Zavadil (1971) at 160 mg/kg body weight and by Poole et al. (1971) at the dose rates of 110 mg/kg, 157 mg/kg and 220 mg/kg body weight. Guralp and Igin (1966), Pal (1970), Poolcoy et al. (1971) and Ibragimov (1976) all got 100% efficacy against experimental Multiceps multiceps infection in dogs with niclosamide at dose levels of 100 to 250 mg/kg, 3 - 4 gm/animal, 100 mg/kg and 200 mg/kg body weight, respectively. Pal (1970) tried niclosamide at the dose rate of 4 g per adult dog and 3 g per pup in infection with M. gaigeri and obtained cent per cent efficacy in the treatments. The efficacy of Niclosamide against Echinococcus granulosus is quite variable. Kurelec and Rijavec (1961) gave niclosamide at dosage of 100 mg/kg body weight to 4 dogs and at autopsy found that 3 of them were completely cleared of the infection. Delak et al. (1963) found the drug at 300 mg/kg to be effective in one third of the dogs treated and 500 mg/kg to be so in 76.9% of the cases. But, the drug has given very little effect against experimental E. granulosus infection in dogs at dose levels of 50 mg/kg, 100 mg/kg and 150 mg/kg in the experiment conducted by Forbes (1963). Cordero del Campillo et al. (1965) has got good results against E. granulosus infection in dogs with

niclosamide at 500 mg/kg body weight. Merdiven (1968), Matchanov and Paramanova (1973), Demidov et al. (1974), Kozakiewicz et al. (1975), Ibragimov (1976), Matchanov et al. (1977) and Deka et al. (1981) used niclosamide at dose rates of 100 and 200 mg/kg, 200 mg/kg, 500 mg/kg, 200 mg/kg and 200 mg/kg respectively and got efficacy of 90%, 98%, 0, 100%, 66-72.3% and 34.7% respectively. Winters (1981) dewormed a dog infected with Mesocestoides corti with niclosamide at 150 mg/kg on 3 occasions. Speckmann and Webster (1975) successfully treated a poodle infected with Mesocestoides sp. by using Yomesan at 4 doses of 500 mg/kg body weight. Matchanova and Paramanova (1973) used phenasal at 200 mg/kg body weight and got complete cure in experimental infections in dogs with Multiceps or Echinococcus or combination of these parasites. Demidov et al. (1974) used phenasal at 200 mg/kg and bunamidine hydrochloride at 50 mg/kg together and got 100% efficacy against experimental E. granulosus infection in dogs. Gavrilov (1978) treated dogs harbouring tapeworms with 3:1 mixture of phenasal and bunamidine hydroxynaphthoate at 100 mg/kg body weight and obtained 100% effect against Taenia hydatigena as well as Multiceps multiceps and 71.5% effect against Echinococcus granulosus. Orapov et al. (1978) used food granules containing ivermectin and phenasal at the rate of

20 mg and 250 mg/kg body weight, respectively, and got 100% efficacy against *Multiceps* as well as *Taenia hydatigena* and 73% efficacy against *Echinococcus granulosus*. Bekirov et al. (1979) used granules containing phenasal with salt, garlic and novocain at 250 mg/kg body weight dose level against *Echinococcus* or *Taenia hydatigena* infection in dogs with 92 - 94.8% and 100% efficacy, respectively.

Praziquantel (2 (cyclohexane-carbonyl) - 4-oxo - 1.2.3.4.6.7.11b-hexahydro - 4H - pyrazino (2,1-a) - isoquinoline), marketed as Droncit by Bayer, Leverkusen, Germany is claimed to be a very effective anticestodal drug, especially for dogs and cats. Guralp et al. (1976a) found the drug to be effective against *T. hydatigena* at the dose level of 1 - 10 mg/kg body weight. The efficacy of the drug against *T. hydatigena* in dogs has been confirmed by Dey-Harza et al. (1976) at 2 mg/kg; by Guralp et al. (1976b) at 1 mg/kg; by Gyul'gyazlı (1977) at 2.5 mg/kg, by Gemmell et al. (1977) at about 1.25 mg/kg; by Thomas and Andrews (1977) at 5 mg/kg and by Badlock et al. (1977) at 2.5 mg/kg body weight in dogs. Praziquantel has also been found to be effective against *Taenia ovisiformis* infection in dog at 1 mg/kg by Dey -Harza (1976); at 5 mg/kg by Thomas and Andrews (1977); at 5 mg/kg by Thomas and Gonnert (1978) and at 2 mg/kg by Sakomoto et al. (1979).



Gyul'gyazli (1977) noticed the drug to be 100% effective at 2.5 mg/kg body weight against Multiceps multiceps infection in dogs. Gemmell et al. (1977) as well as Thomas and Andrews (1977) reported cent per cent efficacy with praziquantel against Taenia ovis in dogs at 1.25 mg/kg and 5 mg/kg body weight respectively. The drug has also been noted to be very effective against Echinococcus infection in dogs. Zukovic et al. (1976), Guralp et al. (1976a), Dey-Harza (1976) and Guralp et al. (1976b) recorded 100% efficacy for the drug against experimental E. granulosus infection in dogs at dose rates of 5 or 10 mg/kg, 1 to 10 mg/kg, 5 and 10 mg/kg and 5 mg/kg body weight respectively. Wikerhauser et al. (1976) got 97.3%, 99.3% and 99.5% efficacy respectively against 4-day old E. granulosus infection in pups at dose rates of 2.5 mg/kg, 5 mg/kg and 10 mg/kg body weight. Thomas and Andrews (1977) could completely remove E. granulosus infection from dog with praziquantel at 5 mg/kg body weight. Gemmell et al. (1977) had effectively traced E. granulosus infection with praziquantel at 1.25 mg/kg body weight. However, Gyul'gyazli (1977) did not get full efficacy against E. granulosus infection in dogs with praziquantel at 5 mg/kg body weight. Himonas et al. (1978) tried praziquantel at 5 mg/kg body weight in pups infected with E. granulosus and got 98.96% efficacy against 12-day old, 100% efficacy against 24-day old and 99.96% against 36-day

old worms. Kobulej and Varga (1978) recorded 99.99% efficacy for praziquantel at 3-5 mg/kg body weight. Beck et al. (1980a) and (1980b) has recorded 100% efficacy against E. granulosus infection in dogs with praziquantel at 5 mg/kg body weight. Gemmell et al. (1980) tried praziquantel through intramuscular, oral as well as suocutaneous routes and got similar effects. Dorichies et al. (1980) noticed praziquantel to be completely effective against natural or experimental Echinococcus infection. Deka et al. (1981) also recorded 100% efficacy against E. granulosus in dogs with praziquantel 5 - 10 mg/kg. Thomas and Andrews (1977), and Sakamoto (1977) effectively treated E. multilocularis infection in dogs with praziquantel at 5 mg/kg and 10 mg/kg body weight, respectively. Thomas and Gonnert (1978) has summarised the result of treatment of various species of tapeworms in dogs with praziquantel and stated that a dose of 5 mg/kg body weight is effective. Sakamoto et al. (1979) got 100% efficacy against E. multilocularis in dogs with praziquantel at 10 mg/kg body weight. The efficacy of praziquantel against Dipylidium caninum in dogs was found to be 100% by Guralp et al. (1976a), Dey-Harza (1976), Guralp et al. (1976b) Gyul'gyazli (1977), Thomas and Andrews (1977), Thomas (1977), Thomas and Gonnert (1978), Sakamoto et al. (1979) and Dorichies et al. (1980) at dose

rates of 1 to 10 mg/kg, 2.5 mg/kg, 2.5 mg/kg, 5 mg/kg, 5 mg/kg, 5 mg/kg, 2.5 mg/kg and 5 mg/kg, respectively. The drug was also found to be effective against Mesocostoides corti by Thomas and Andrews (1977) at 50 mg/kg, Thomas and Gonnert (1978) at 5 mg/kg and Sakamoto et al. (1979), at 2 mg/kg body weight. Praziquantel has been found to be 100% effective against Diphyllbothrium latum by Sakamoto (1977) at 35 mg/kg, and Sakamoto et al. (1979) at 35 mg/kg body weight. Sakamoto et al. (1979) also noticed 100% efficacy for the drug against D. erinacei at 20 mg/kg body weight.

Taenml, an ayurvedic anthelmintic developed by the Indian Herbs Research & Supply Co., Sahranpur, is claimed to cause the complete expulsion of tapeworms, along with scolices. Siya and Iripathy (1981) tried taenml in 5 pups experimentally infected with Taenia hydatigena at the dose rate of 500 mg/kg body weight orally once a day for 3 consecutive days beginning the 23th day of infection and found the drug to be having 100% efficacy.

## *Results*

---

## RESULTS

### EFFICACY OF ANTHELMINTICS AGAINST Taenia hydatigena

The efficacy of Albendazole at the dose rates of 12.5 mg/kg body weight was only 40% while the efficacy of the drug at 25 mg/kg body weight was 100%.

Amodiaquin did not show any efficacy at all at the rate of 10 mg/kg body weight and showed an efficacy of only 20% at the dose rate of 20 mg/kg body weight as evidenced by the recovery of 4 live worms in each of the 2 cases treated at this dosage.

Fenbendazole showed an efficacy of only 20% at the dose rate of 5 mg/kg body weight as both the animals treated yielded 4 worms, each at autopsy examination. The drug was, however, 100% effective at the higher dose rates of 10 mg/kg body weight and 20 mg/kg body weight.

Hexachloroprene at the dose rate of 7.5 mg/kg body weight exhibited an efficacy of 60% while its efficacy was 100% at the dose rate of 15 mg/kg body weight.

Mebendazole did not show any activity against Taenia hydatigena at the dose rate of 7.5 mg/kg body weight, repeated for 3 consecutive days. However, the drug was 100% efficacious at the dose rates of 15 mg/kg as well as 30 mg/kg body weight, both repeated for 3 consecutive days.

Oxyclozanide (3: 3, 5, 5, 6 - pentachloro 2-2-dihydroxy benzanilide) available as a 3.4% W/V solution (Zanil, I.C.I.), was tried only at the dose rate of 34 mg/kg (1 ml/kg) body weight and was found to have a low efficacy of 20% in one case and 40% in the other.

Praziquantel was given at 3 dose rates of 2.5 mg/kg, 5 mg/kg and 10 mg/kg body weight and was found to be completely effective at the above dosages in all the cases.

Taenil, which was given at the dose rate of 500 mg/kg for 3 consecutive days had no effect at all, as revealed by the recovery of 5 viable worms from each of the two treated dogs, during autopsy.

#### EFFICACY OF ANTHELMINTIC AGAINST Echinococcus granulosus

The only drug that was tried against E. granulosus was Fenbendazole at the dose rates of 5 mg/kg, 10 mg/kg and 20 mg/kg body weight. The drug was not completely efficacious, the efficacy obtained at the 3 dose rates being only nil, 20% and 40%, respectively.

#### EFFICACY OF ANTHELMINTICS AGAINST Dipylidium caninum

Albendazole given at the dose rates of 12.5 mg/kg body weight was only 10% effective while its efficacy was 25% at the dose rate of 25 mg/kg body weight.

Amodiaquin was tried at the dose rates of 10 mg/kg body

weight as well as at 20 mg/kg body weight and was found to be totally ineffective at both the dosages.

The efficacy of Fenbendazole at the dose rate of 5 mg/kg body weight was only 10% while its efficacy at 10 mg/kg body weight as well as at 20 mg/kg body weight was 100%.

Hexachlorophene which had been tried at the dose rates of 7.5 mg/kg and 15 mg/kg body weight showed efficacy of 25% at the lower dose rate and 60% at the higher dose rate.

Mebendazole, at the dose rate of 7.5 mg/kg body weight repeated for 3 consecutive days did not show any effect at all, while at the 3 day repeated dose rates of 15 mg/kg as well as 30 mg/kg body weight, the drug showed 100% efficacy.

The efficacy of Niclosamide at the dose rates of 62.5 mg/kg body weight was only 20%. While at the higher dose rates of 125 mg/kg body weight and 250 mg/kg body weight the efficacy of the drug was noted to be 100%.

Oxyclozanide at the dose rate of 34 mg/kg body weight revealed only very low efficacies of 10% and 12.5% respectively.

Praziquantel was tried at the dose rates of 5 mg/kg as well as 10 mg/kg body weight and proved to be 100% efficacious at both the dosages.

Taenil was given at the dosage of 500 mg/kg body weight daily for 3 consecutive days and did not show any efficacy at this dosage against D. caninum.

*Tables*

---



Table I

Incidence of cestodes in dogs, assessed by autopsy screening.

a) Overall incidence

Total number of dogs examined	Total number of dogs infected	Total number of dogs found to be infected with						
		<u>Dipyl- dium</u> <u>caninum</u>	<u>Joyeuxi- ella</u> <u>pasqualei</u>	<u>Echino- coccus</u> <u>granulosus</u>	<u>D. caninum</u> & <u>J. pasqualei</u>	<u>D. caninum</u> & <u>T. hydatigena</u>	<u>D. caninum</u> & <u>E. granulosus</u>	<u>T. hydatige</u> & <u>E. granulos</u>

88

49

39

2

2

2

1

2

1

**Table I**  
**Incidence of cestodes in dogs, assessed by autopsy screening**  
**b) Overall incidence according to host age groups**

Sl. No.	Host age group	Sex	Number examined	<u>Dipylidium caninum</u>	<u>Joyeuxiella pasqualei</u>	<u>Taenia hydatigena</u>	<u>Echinococcus granulosus</u>
1.	Upto 6 months	Male	16	6	1	-	-
		Female	24	14	-	-	-
2.	Above 6 months upto, one year	Male	5	5	-	-	-
		Female	6	2	1	-	-
3.	Above one year upto 2 years	Male	1	-	-	-	-
		Female	3	-	-	-	-
4.	Above 2 year upto, 5 years	Male	14	7	1	1	1
		Female	9	3	1	-	1
5.	Above 5 years	Male	7	6	-	-	2
		Female	3	1	-	1	1
<b>Total</b>			88	44	4	2	5

Table II

Incidence of cestodes in dogs, assessed by autopsy screening

a) Incidence in host age group upto 6 months.

Sex	Number of animals examined.	Sl. No.	Age	<u>Dipylidium caninum</u>	<u>Joyeuxiella pasqualei</u>	<u>Taenia hydatigena</u>	<u>Echinococcus granulosus</u>
Male	16	1	1 month	+	-	-	-
		2	1 month	+	-	-	-
		3	1 month	+	-	-	-
		4	5 months	+	+	-	-
		5	5 months	+	-	-	-
		6	6 months	+	-	-	-
Female	24	1	1 month	+	-	-	-
		2	1 month	+	-	-	-
		3	1 1/4 month	+	-	-	-
		4	1 1/2 month	+	-	-	-
		5	1 3/4 month	+	-	-	-
		6	1 3/4 month	+	-	-	-
		7	2 months	+	-	-	-
		8	2 months	+	-	-	-
		9	2 months	+	-	-	-
		10	2 months	+	-	-	-
		11	5 months	+	-	-	-
		12	6 months	+	-	-	-
		13	6 months	+	-	-	-
		14	6 months	+	-	-	-
b) Incidence in host age group above 6 months and upto 1 year							
Male	5	1	7 months	+	-	-	-
		2	8 months	+	-	-	-
		3	8 months	+	-	-	-
		4	1 year	+	-	-	-
		5	8 months	+	-	-	-
Female	6	1	7 months	+	+	-	-
		2	10 months	+	-	-	-

'+ ' indicates positive cases.

## c) Incidence in host age group above 1 year and upto 2 years.

Sex	Number of animals examined.	Sl. No.	Age	<u>Dipylidium caninum</u>	<u>Joyeuxiella pasqualei</u>	<u>Taenia hydatigena</u>	<u>Echinococcus granulosus</u>
Male	1			-	-	-	-
Female	3			-	-	-	-

## d) Incidence in host age group above 2 years and upto 5 years.

		1	3 years	-	+	-	-
		2	3 years	+	-	-	-
		3	4 years	+	-	-	-
		4	4 years	+	-	+	-
Male	14	5	4 years	+	-	-	-
		6	5 years	+	-	-	-
		7	5 years	+	-	-	-
		8	5 years	+	-	-	-
		9	5 years	-	-	-	-
		1	3½ years	+	-	-	-
		2	4 years	+	-	-	-
Female	9	3	4 years	-	-	-	+
		4	5 years	+	-	-	-
		5	5 years	-	+	-	-

## e) Incidence in host age group above 5 years.

		1	6 years	+	-	-	+
		2	6 years	+	-	-	-
Male	7	3	6 years	+	-	-	-
		4	6 years	+	-	-	+
		5	6 years	+	-	-	-
		6	8 years	+	-	-	-
Female	3	1	6 years	-	-	+	+
		2	8 years	+	-	-	-

'+' indicates positive cases.

Table III  
Intensity of Dilepidid cestode infection in dogs.

a) Intensity in host age group upto 6 months.

Sex	Sl. No.	Age	<u>Dipylidium caninum</u>			<u>Joyeuxiella pasqualei</u>		
			Juvenile	Mature	Gravid	Juvenile	Mature	Gravid
Male	1	1 month	0	8	17	-	-	-
	2	1 month	30	0	0	-	-	-
	3	1 month	8	34	28	-	-	-
	4	5 months	0	8	15	0	0	2
	5	5 months	8	12	16	-	-	-
	6	6 months	0	0	3	-	-	-
Female	1	1 month	15	25	20	-	-	-
	2	1 month	20	25	5	-	-	-
	3	1½ month	5	12	21	-	-	-
	4	1½ month	2	5	8	-	-	-
	5	1¾ month	4	7	9	-	-	-
	6	1½ month	0	5	45	-	-	-
	7	2 months	0	0	6	-	-	-
	8	2 months	10	25	65	-	-	-
	9	2 months	4	6	20	-	-	-
	10	2 months	10	24	31	-	-	-
	11	5 months	0	6	2	-	-	-
	12	5 months	0	0	1	-	-	-
	13	6 months	0	0	1	-	-	-
	14	6 months	2	6	4	-	-	-

b) Intensity in host age group above 6 months and upto 1 year

Male	1	7 months	0	1	1	-	-	-
	2	8 months	2	4	6	-	-	-
	3	8 months	3	8	9	-	-	-
	4	1 year	0	0	8	-	-	-
	5	8 months	1	0	2	-	-	-
Female	1	7 months	0	0	3	0	0	6
	2	10 months	0	0	4	-	-	-

c) Intensity in host age group above 1 year and upto 2 years.

Male	-	-	-	-	-	-	-
Female	-	-	-	-	-	-	-

d) Intensity in host age group above 2 years and upto 5 years.

Sex	Sl. No.	Age	<u>Dipylidium caninum</u>			<u>Joyeuxiella pasqualei</u>		
			Juvenile	Mature	Gravid	Juvenile	Mature	Gravid
	1	3 years	-	-	-	5	6	7
	2	3 years	2	0	0	-	-	-
Male	3	4 years	0	0	2	-	-	-
	4	4 years	0	5	10	-	-	-
	5	4 years	0	2	0	-	-	-
	6	5 years	5	0	20	-	-	-
	7	5 years	2	5	9	-	-	-
	8	5 years	0	9	6	-	-	-
	9							
Female	1	3½ years	0	5	0	-	-	-
	2	4 years	4	18	38	-	-	-
	3	5 years	2	2	0	-	-	-
	4	5 years	-	-	-	0	1	2

e) Intensity in host age group above 5 years

	1	6 years	0	0	3	-	-	-
Male	2	6 years	0	12	60	-	-	-
	3	6 years	0	9	11	-	-	-
	4	6 years	0	1	1	-	-	-
	5	6 years	2	4	4	-	-	-
	6	8 years	0	8	7	-	-	-
Female	1	8 years	0	2	5	-	-	-

Table IV  
Intensity of Taeniid cestode infection in dogs.

a) Intensity in host age group upto 6 months

Sex	Sl. No.	Age	<u>Taenia hydatigena</u>			<u>Echinococcus granulosus</u>		
			Juvenile	Mature	Gravid	Juvenile	Mature	Gravid
Male			-	-	-	-	-	-
Female			-	-	-	-	-	-

b) Intensity in host age group above 6 months upto 1 year.

Male			-	-	-	-	-	-
Female			-	-	-	-	-	-

c) Intensity in host age group above 1 year upto 2 years.

Male			-	-	-	-	-	-
Female			-	-	-	-	-	-

d) Intensity in host age group above 2 years upto 5 years.

Male	1	4 years	0	0	2	-	-	-
	2	5 years	-	-	-	0	80	300
Female	1	4 years	-	-	-	0	14	26

e) Intensity in host age group above 5 years.

Male	1	6 years	-	-	-	0	160	340
	2	6 years	-	-	-	0	50	250
Female	1	6 years	0	0	1	0	10	26

Table V  
Incidence of cestodes in dogs assessed by faecal sample examination.

Host age group	Sex	No. of animals examined.	Cestode proglottids encountered				Cestode ova encountered				
			<u>Diphylo-</u> <u>bothrium</u> sp.	<u>Dipylis-</u> <u>dium</u> sp.	<u>Joyeuxi-</u> <u>ella</u> sp.	<u>Taenia</u> sp.	<u>Echino-</u> <u>coccus</u> sp.	<u>Diphylo-</u> <u>bothrium</u> sp.	<u>Dipylis-</u> <u>dium</u> sp.	<u>Joyeuxi-</u> <u>ella</u> sp.	<u>Taenid</u> sp.
Upto 6 months	Male	31	-	14	-	-	-	-	-	-	
	Female	21	-	3	-	-	-	-	1	-	
Above 6 months upto 1 year	Male	6	-	-	-	-	-	-	-	-	
	Female	7	-	-	-	-	-	-	-	-	
Above 1 year upto 2 years	Male	5	-	-	-	-	-	-	-	-	
	Female	5	-	-	-	-	-	-	-	-	
Above 2 years upto 5 years	Male	19	-	-	-	-	1	-	-	-	
	Female	10	-	-	-	-	-	-	-	1	
Above 5 years	Male	11	-	-	-	-	-	-	-	-	
	Female	4	-	-	-	-	-	-	-	-	



Table VI

Incidence of cestodes in dogs assessed by faecal sample examination.  
a) Incidence in host age group upto 6 months.

Sex	No. of animals examined.	Sl. No.	Age	Locality	Cestode proglottids encountered				Cestode ova encountered			
					<u>Diphylo-</u>	<u>Dipyli-</u>	<u>Echino-</u>	<u>Diphylo-</u>	<u>Dipyli-</u>	<u>Joyeuxi</u>	<u>Faen-</u>	
					<u>bothrium</u>	<u>dium</u>	<u>Taenia</u>	<u>coccus</u>	<u>bothrium</u>	<u>dium</u>	<u>ella</u>	<u>iid</u>
				sp.	sp.	sp.	sp.	sp.	sp.	sp.	sp.	
Male	31	1	1 month	Mannuthy	-	+	-	-	-	-	-	-
		2	1 month	Mannuthy	-	+	-	-	-	-	-	-
		3	1 month	Mukkattukara	-	+	-	-	-	-	-	-
		4	1 month	Kalathode	-	+	-	-	-	-	-	-
		5	1 month	Kalathode	-	+	-	-	-	-	-	-
		6	1 month	Mannuthy	-	+	-	-	-	-	-	-
		7	1 month	Mannuthy	-	+	-	-	-	-	-	-
		8	1½ month	Nadathara	-	+	-	-	-	-	-	-
		9	1½ month	Mudicode	-	+	-	-	-	-	-	-
		10	1½ month	Pattikkad	-	+	-	-	-	-	-	-
		11	1½ month	Pattikkad	-	+	-	-	-	-	-	-
		12	1½ month	Mannuthy	-	+	-	-	-	-	-	-
		13	2 month	Mannuthy	-	+	-	-	-	-	-	-
		14	2 month	Nallankara	-	+	-	-	-	-	-	-
Female	21	1	1 month	Mannuthy	-	+	-	-	-	-	-	-
		2	2 month	Mannuthy	-	+	-	-	-	-	-	-
		3	3½ month	Mukkattukara	-	+	-	-	-	-	-	-
		4	6 month	Nadathara	-	-	-	-	-	+	-	-

'+' indicates positive cases.

b) Incidence in host age group above 6 months upto  
1 year.

Sex	No. of animals examined	Sl. No.	Age	Locality	Cestode proglottids encountered				Cestode ova encountered			
					<u>Diphyllo-</u> <u>bothrium</u> sp.	<u>Dipylti-</u> <u>dium</u> sp.	<u>Taenia</u> <u>coccus</u> sp.	<u>Echinc-</u> <u>coccus</u> sp.	<u>Diphyllo-</u> <u>bothrium</u> sp.	<u>Dipylti-</u> <u>dium</u> sp.	<u>Joyeu-</u> <u>xiella</u> sp.	<u>Tae-</u> <u>niid</u> sp.
Male	6				-	-	-	-	-	-	-	-
Female	7				-	-	-	-	-	-	-	-

c) Incidence in host age group above 1 year upto  
2 years.

Male	5				-	-	-	-	-	-	-	-
Female	5				-	-	-	-	-	-	-	-

d) Incidence in host age group above 2 years upto  
5 years.

Male	19	1	4½ years	Mullakkara	+	-	-	-	+	-	-	-
Female	10	1	4 years	Kunnankulam	-	-	-	-	-	-	-	+

e) Incidence in host age group above 5 years.

Male	11				-	-	-	-	-	-	-	-
Female	4				-	-	-	-	-	-	-	-

Name of the drug	Albendazole		Amodiaquin		Fenbendazole			Hexachlorophen			
	12.5 mg/kg	25 mg/kg	10 mg/kg	20 mg/kg	5 mg/kg	10 mg/kg	20 mg/kg	7.5 mg/kg	15 mg/kg		
Sl. No. of animals treated	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2		
No. of larval scolices given	5 5	5 5	5 5	5 5	5 5	5 5	5 5	5 5	5 5		
No. of worms expected to be present	5 5	5 5	5 5	5 5	5 5	5 5	5 5	5 5	5 5		
No. of worms recovered at autopsy	3 4	0 0	5 5	5 4	4 5	1 0	0 0	2 2	1 0		
Stage of worms recovered	Live <sup>3</sup> <sub>1</sub> live dead	- -	live live	live <sup>4</sup> <sub>1</sub> live live <sup>4</sup> <sub>1</sub> dead	live live	live <sup>4</sup> <sub>1</sub> live live <sup>4</sup> <sub>1</sub> dead	live <sup>4</sup> <sub>1</sub> live live <sup>4</sup> <sub>1</sub> dead	dead-	- -	live live	live live dead-
Efficacy of the drug	40% 40%	100% 100%	nil nil	20% 20%	20% 20%	100% 100%	100% 100%	60% 60%	100% 100%		

Table VII  
 Efficacy of anthelmintics against Taenia hydatigena

Mebendazole @			Niclosamide					Oxyclozanide				Praziquantel				Taenil §					
5 mg/kg	15 mg/kg	30 mg/kg	62.5 mg/kg	125 mg/kg	250 mg/kg	34 mg/kg	2.5 mg/kg	5 mg/kg	10 mg/kg	500 mg/kg											
2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
5	2	1	0	0	1	2	0	0	0	0	4	3	2	2	0	1	0	0	5	5	
e	live	dead	dead	-	-	dead	dead	-	-	-	-	live	live	dead	dead	-	dead	-	-	live	live
1	nil	100%	100%	100%	100%	100%	100%	100%	100%	100%	20%	40%	100%	100%	100%	100%	100%	100%	100%	nil	nil

@ Treatment repeated for 3 consecutive days  
 § daily for 3 consecutive days.

Name of the drug	Albendazole				Amodiaquin				Fenbendazole				Hexachloroph					
Dosage	12.5 mg/kg	25 mg/kg	10 mg/kg	20 mg/kg	10 mg/kg	20 mg/kg	5 mg/kg	10 mg/kg	20 mg/kg	5 mg/kg	10 mg/kg	20 mg/kg	7.5 mg/kg	15				
Sl. No. of animals treated	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	
Average No. of gravid segments passed before treatment(+)	5	19	3	4	2	5	7	2	5	8	4	2	4	2	7	9	11	
No. of scolex recovered after treatment from the faeces	live	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	dead	4	1	-	1	-	-	-	-	2	1	-	3	-	-	3	1	
No. of worms recovered at autopsy	live	9	18	6	9	9	16	18	7	18	27	-	-	-	16	24	20	
	dead	1	1	2	3	-	-	-	-	2	1	12	9	7	6	4	3	4
Computed total No. of worms	10	20	8	12	9	16	18	7	20	30	13	9	10	6	20	30	25	
Efficacy of the drug (==)	10%	10%	25%	25%	nil	nil	nil	nil	10%	10%	100%	100%	100%	100%	20%	20%	25%	2

(+) A total No. of gravid segments passed during the 3 days prior to treatment was assessed by examination of the faecal material passed during the period by each animal and the average for the 3 days calculated.

(==)The efficacy is determined as percentage of dead worms to the total No. of worms.

Table VIII

Efficacy of anthelmintics against Dipylidium caninum

Mebendazole(&)		Niclosamide				Oxyclozanide		Praziquantel		Taenil(&)								
5 mg/kg	15 mg/kg	30 mg/kg	62.5 mg/kg	120 mg/kg	250 mg/kg	34 mg/kg	5 mg/kg	10 mg/kg	500 mg/kg									
2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
5	3	4	2	3	8	2	9	5	4	2	6	8	3 <sup>+</sup>	5	2	2	8	6
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	3	1	2	-	-	-	13	4	1	-	1	-	-	2	-	1	-	-
14	-	-	-	-	12	4	-	-	-	-	18	21	-	-	-	-	27	18
-	8	14	7	8	3	1	18	13	10	8	1	3	12	13	4	5	-	-
14	11	15	9	8	15	5	21	13	11	8	20	24	12	15	4	6	27	18
nil	100%	100%	100%	100%	20%	20%	100%	100%	100%	100%	10%	12.5%	100%	100%	100%	100%	nil	nil

Treatment repeated for 3 consecutive<sup>1</sup> days.

Table IX  
Efficacy of anthelmintic against Echinococcus  
granulosus

Drug	Fenbendazole					
	5 mg/kg		10 mg/kg		20 mg/kg	
Sl. No. of animals treated	1	2	1	2	1	2
No. of protoscolices given	2000	2000	2000	2000	2000	2000
No. of worms expected to be present	1000	1000	1000	1000	1000	1000
No. of worms recovered at autopsy	1100	1020	790	808	580	610
Stage of worms recovered	live	live	live	live	live	live
Efficacy of the drug	nil	nil	20%	20%	40%	40%

## *Discussion*

---



## DISCUSSION

The autopsy screening carried out during the present studies revealed the occurrence of only 4 species of cestodes, namely Dipylidium caninum, Joyeuxiella pasqualei, Echinococcus granulosus and Taenia hydatigena.

Of these 4 species of cestodes, D. caninum showed the highest overall incidence of 50%. This was in conformity with the findings of Abo-Shady (1980) who recorded an incidence of 62.4% for the parasite among stray dogs in Egypt; Costa et al. (1971) who recorded incidence of 47.2% for D. caninum in pariah dogs in Texas; Ohishi et al. (1973) who recorded incidence of 49.2% in Tokyo and Sahasrabudhe et al. (1969) who recorded incidence of 47% in dogs in Madhya Pradesh. Only lower incidence rate of 20% was encountered by Kannagara and Karunaratne (1970) in Colombo, 18% in Iran by Mirzayans et al. (1972) & 25% in Bihar by Kumar & Sahai (1972).

The incidence of T. hydatigena recorded by autopsy screening during the present studies was only 2.27%. This was in conformity with the findings of Palmieri et al. (1978) in Utah (2%); Tassi and Widenhorn (1971) in Rome (1%) and Sawyer et al. (1975) in Utah (4%) but much higher incidences were recorded by Dada (1980) as well as Dada et al. (1979) in Nigeria (66.2% to 77.9); Dent and Kelly (1976) in Balyney (33.33%); Sahai (1969) in Barielly, India (31.37%); Sahasrabudhe et al. (1969) in Madhya

Pradesh (23%) and Kumar and Sahai (1972) in Patna (19.4%).

The incidence of E. granulosus recorded during the present studies was 5.67%. This was in conformity with the findings of Saleh & Ahmed (1965) in Karachi (7%) and Mirzayans et al. (1972) in Tehran (8%). Higher incidence rates were recorded by Gemmoll (1957) in New South Wales, Australia (25.6%); and by Hussain and Akhtar (1969) in Lahore (25%).

The incidence of J. pasqualei was noted to be 4.5% during the present studies and there is no previous data regarding the incidence of the parasite in dogs.

Out of the 119 dogs screened for cestode infection by faecal sample examination, 18 animals (15.1%) were found to be positive for D. caninum infection. This observation is in general conformity with the findings of Jackson & Arundel (1971) who encountered an incidence of 17% infection in dogs in the State of Victoria, Australia; Chaneeet and White (1970) who encountered an incidence of 16.4% in Albany area of Western Australia and Dent & Kelly (1976) who encountered an incidence of 13.6% in Blayney, New South Wales, Australia. Higher incidence rate had been recorded by Kelly (1975) in Sydney, Australia (67.5%); Williams (1976) in Dyfed, South Wales, U.K. (45.1%); Dada and Belino (1979) in Zaria, Nigeria (67.5%) and by Arru and Nieddu (1979) in Sardinia (74.67%) whereas lower incidence rates had been recorded by Mirzayans

et al. (1972) in Iran (3%); Fernandes et al. (1973) in Parana, Brazil (2%); Bazzochi and Canestri - Trotti (1979) in Forlì, Italy (2.5%) and by Mohanlal (1982) in Kerala (3.23%).

The incidence of Diphyllbothrium latum infection as determined by faecal sample examination during the present studies was only 0.8% and was comparable to that of Schawalder (1976) who encountered only 1.4% positive cases in Bern, Switzerland.

The incidence of taeniid tape worm infection detected by faecal sample examination during the present studies was 0.8% and the specific identity of the parasite involved in the case could not be determined. The low rate of incidence observed is comparable to the findings of Mituch (1968) who encountered T. hydatigena infection in only 1.6% of mongrel dogs and none pure-bred dogs and Multiceps multiceps infection in only 3.1% and none of the above animals in Slovakia. However, Shepelev (1958) and Schantz et al. (1977) observed higher rates of 16.3% and 45.5% infection with T. hydatigena in dogs in U.S.S.R. and U.S.A., respectively, by faecal sample examination. While Sims and Sanchez (1979) and Islam (1980) recorded higher rates of 31.2% and 62.5% infection with E. granulosus in Chile and Bangladesh respectively by faecal sample examination.

The anthelmintic efficacy of Albendazole against T. hydatigena at the dose rate of 25 mg/kg body weight was 100%, even though the efficacy at the dose rate of 12.5 mg/kg body weight was only 40%. Georgi (1980) found the drug to be active against Taenia species in dogs at multiple dosage of 25 mg/kg body weight for .

5 days only. During the present studies the drug exhibited only a low efficacy of 30% at the dose rate of 25 mg/kg body weight which is in conformity with the observation of Georgi (loc. cit.).

In the present studies, Fenbendazole was found to be cent per cent efficacious against both T. hydatigena and D. caninum at the dose rates of 10 mg/kg as well as 20 mg/kg body weight, though the efficacy of the drug at the dose rates of 5 mg/kg body weight against these parasites were very low, being only 20% and 10% respectively. The finding supports the view of Gemmell et al. (1977b) that the drug reduces worm burden with T. hydatigena in experimentally infected dogs at single dose of either 20 mg/kg or 80 mg/kg body weight. The efficacy of the drug against E. granulosus was noted to be nil, at 5 mg/kg body weight, 20% at 10 mg/kg body weight and 40% at 20 mg/kg body weight.

The efficacy of hexachlorophene observed during the present studies was 60% and 100% against T. hydatigena at the dose rates of 7.5 mg/kg and 15mg/kg body weight, respectively, while its efficacies against D. caninum at the above dose rates were 25% and 60%, respectively only. Demidov and Aminzhanov (1975) noted the drug to be 88.9% to 100% efficacious against T. hydatigena at 15 mg/kg body weight and the present finding agrees in general with this observation.

Mebendazole exhibited cent per cent efficacy against T. hydatigena during the present studies at the dose rates of 15 mg/kg as well as 30 mg/kg both, repeated for 3 consecutive days; even though the

efficacy of the drug at the lower dosage of 7.5 mg/kg body weight was nil. Vanparijs and Thienpont (1973) obtained only 77.7% efficacy for the drug against T. hydatigena at the dosage of 100 mg/kg twice daily for 5 days. While Gemmell et al. (1975) noted that the drug could clean T. hydatigena infection at the dose rates of 40 mg/kg body weight. Siva and Tripathy (1981) had obtained 100% efficacy for the drug against T. hydatigena infection at the dose rate of 100 mg/kg body weight for three days; which is a much higher dosage than the present one. The present finding of 100 per cent efficacy of the drug against D. caninum at the dose rate of 15 mg/kg as well as 30 mg/kg body weight, for 3 consecutive days differs from that of Vanparijs and Thienpont (1973), who obtained similar effects at a higher dosage of 100 mg/kg twice daily for 5 days.

The high efficacy of Niclosamide encountered during the present studies is in general agreement with the findings of Kurelec and Rajavec (1961). The present finding of 100 per cent efficacy against T. hydatigena infection at the dosages of 62.5 mg/kg, 125 mg/kg, and 250 mg/kg body weight corroborates with the findings of Forbes (1963) and Matchanov et al. (1977). The good results of the drug against D. caninum at the dosages of 125 mg/kg body weight as well as 250 mg/kg body weight agrees with the observations of Poole et al. (1971), as well as Neumann and Zavadil (1971).

The high efficacy of praziquantel observed during the present studies against T. hydatigena at the dose rates of 2.5 mg/kg, 5 mg/kg; and 10 mg/kg body weight agrees with the observations of

Guralp et al. (1976), Dey-Harza et al. (1976), Gyul'gyazali (1977), Gemmell et al. (1977), Thomas and Andrews (1977) and Badlock et al. (1977). The high efficacy of the drug against D. caninum at the dose rates of 5 mg/kg as well as 10 mg/kg body weight is also in conformity with the observations of Guralp et al. (1976), Dey-Harza et al. (1976), Gyul'gyazali (1977), Thomas and Andrew (1977), Thomas and Gonnert (1973), Sakamoto et al. (1979) and Dorichies et al. (1980).

Taenil, gave no effect at all during the present studies against T. hydatigena or D. caninum at the dose rates of 500mg/kg body weight given for 3 consecutive days. This finding is in total disagreement with that of Siva and Tripathy (1981) who obtained 100% efficacy for the drug at the above dosage schedule against T. hydatigena. The present studies did not show any effect at all for Taenil against D. caninum also.

# Summary

---

## SUMMARY

1. An investigation has been made into the incidence of cestodes of dogs in Kerala state by autopsy screening of 88 dogs and examination of faecal samples of 119 dogs.

2. The specific identity of the different cestode species harboured by the animals has been determined from the morphology of the worms, gravid segments and eggs encountered during the investigation.

3. A total of five species of cestodes, viz., Dipylidium caninum, Joyeuxiella pasqualei, Diphyllbothrium latum, Taenia hydatigena and Echinococcus granulosus, has been encountered in the dogs during the present studies.

4. The autopsy screening revealed that Dipylidium caninum had the highest incidence (50%) and Taenia hydatigena had the lowest incidence (2.7%). Joyeuxiella pasqualei was present in only 4.54% of the dogs while Echinococcus granulosus was present in 5.67% of the dogs.

5. The highest incidence of Dipylidium caninum was encountered in animals of the age group of above 5 years of which 70% harboured the parasite. The highest incidence of Joyeuxiella pasqualei was encountered in animals of the age group of above 6 months and upto one year (9.09%). The highest incidence with Echinococcus granulosus and Taenia hydatigena occurred in animals of the age group of above 5 years, being 30% and 10% respectively.



6. Joyeuxiella pasqualei was recorded for the first time from dogs during the present studies.

7. Examination of faecal samples revealed that Dipylidium caninum was the most common cestode.

8. Nine anthelmintics viz., Albendazole, Amodiaquin, Fenbendazole, Hexachlorophene, Mebendazole, Niclosamide, Oxyclozanide, Praziquantel and Tacmil, were tried against experimental Taenia hydatigena infection as well as natural cases of Dipylidium caninum infection. Fenbendazole was also tried against experimental Echinococcus granulosus infection.

Albendazole at 25 mg/kg, Fenbendazole at 10 mg/kg and 20 mg/kg, Hexachlorophene at 15 mg/kg, Mebendazole at 15 mg and 30 mg repeated for 3 days, Niclosamide at 62.5 mg/kg, 125 mg/kg and 250 mg/kg and Praziquantel at 2.5 mg/kg, 5 mg/kg and 10 mg/kg were completely effective against Taenia hydatigena infection.

Fenbendazole at the above dose rates had efficacies of 0%, 20% and 40% only against Echinococcus granulosus.

Fenbendazole at 10 mg/kg and 20 mg/kg, Mebendazole at 15 mg/kg and 30 mg/kg repeated for 3 days, Niclosamide at 125 mg/kg and 250 mg/kg and Praziquantel at 5 mg/kg and 10 mg/kg were all 100% effective against Dipylidium caninum while Albendazole and Hexachlorophene, which were quite effective against Taenia hydatigena, were found to be much less effective against Dipylidium caninum.

## *References*

---

## REFERENCES

- Abo-Shady, A.F. (1980). Intestinal helminths among stray dogs in Mansoura City, Egypt. J. Egypt. Soc. Parasit. 10 (2) : 289 - 294.\*
- Alcaino, H. and Tagle, I. (1970). Enteroparasites in dogs in Santiago. Boln. Chil. Parasit. 25 (1/2) : 5 - 8.\*
- Aminzhanov, M. (1977). The efficacy of phenasal and hexachlorophene granules in cestode infections in dogs. Byull. Vseso. Insti. Gelm. Skr. 21 : 7 - 9.\*
- Arru, E. and Nieddu, A.M. (1979). Echinococcosis of dog in Sardinia. Parasitologia 21 (1/3) : 81 - 85\*.
- Badlock, F.C., Flucke, W.J. and Hopkins, T.J. (1977). Efficacy of praziquantel, a new cesticide, against Taenia hydatigena in the dog. Res. Vet. Sci. 23 (2): 237 - 238.
- Banerjee, K.N., Das Gupta, D.K., Ray, S. and Mallick, K.K. (1974). Incidence of Mesocestoides tenuis Meggit, 1931 in a pet dog. Indian J. Anim. Hlth. 13 (2): 179.
- Batte, E.G., McLamb, R.D. and Vestal, T.J. (1971). Incidence of certain intestinal helminths in dogs of Wake county, North Carolina. Florida Vet. J. 2(2): 21 - 23\*.
- Bazzocchi, F. and Canestrì-Trotti (1979). Studies of the parasitic fauna of dogs in some towns in the province of Forlì. Parasitologia 21 (1/3): 87\*.
- Bazzocchi, F. and Canestrì-Trotti, (1980). The intestinal parasitic fauna of dog in some semi-urban and rural areas of the province of Forlì. Parasitologia. 22 (1/2) : 149 - 154.\*
- Beck, A.A., Rassier, D., Chaplin, E., Picavea, J.P.C. and Almeida, A.F. (1980a). The efficacy of Droncit (R) in the control of Echinococcus granulosus in experimentally infected dogs. Vet. Med. Rev. 2 : 135 - 139.\*
- Beck, A.A., Santurio, J.M. and Moreira, W.S. (1980b). Efficacy of praziquantel in the treatment of Echinococcus granulosus in dogs. Rev. Centro Cienc. Rurais. 10(2): 161 - 168.\*

- Bekirov, R.E., Asmirov, S.H., Oripov, A.O. and Dzhumaev, Z. (1979). The efficacy of granules against cestodes in dogs. Veterinariya, Moscow, 8 : 50 - 51.\*
- Buscher, H.N. (1974). Intestinal helminths of dog, Canis familiaris, in Lahore and their potential as contributors to health problems. Pakist. J. Sci. 26 (1/6) : 12 - 14.\*
- Canese, A. (1977). Intestinal helminths found at autopsy in dogs and cats in Asuncion. Rev. Paraguaya Microbiol. 12 (1) : 11\*.
- Carneiro, J.R., Freitas, J.DE.S., Pereira, E., Campos, D.M.P. and Jardim, C.Da.U (1973). Incidence of helminths in dogs (Canis familiaris) in Goiania, Brazil. Rev. Patol. Trop. 2 (4) : 401-404.\*
- Chanee, G.De. and White, J B. (1976). Ovine cysticercosis in the Albany region of Western Australia. I. Survey of tapeworms of rural dogs. Aust. vet. J. 52(2) : 69-72.
- Chieffi, P.P., Viotti, N.M.A., Muller, E.E. and Moretti, I.G. (1976). Prevalence of intestinal parasites in dogs from the urban areas of Londrina, Parana state, Brazil. Cientifica, Sao Paulo 4 (1) : 64 - 67\*.
- Cobbold, T.S. (1858). Cited by Yamaguti (1959).  
Cordero del Campillo, M., Ramirez Fernandez, A.P., Aller Gancedo, B. and Martinez Fernandez, A. (1965). Ensayo experimental de N - (2'chloro-4-nitroferil)-5-chlorosalicilamida frente a Echinococcus granulosus (Batsch, 1786) adutos en el intestino del perro Revta. Iber. Parasit. 25 (1/2) : 119-129.\*
- Costa, J.O., Galvin, f.J., Bell, R.R. and Smyth, J.D. (1971). Survey of helminth parasites of dogs from Brazos county, Texas. Swet. Vet. 24 (4) : 305 - 306.\*
- Dada, B.J.O. (1980). Taeniasis, cysticercosis and echinococcus/ hydatidosis in Nigeria. IV. prevalence of Echinococcus granulosus infection in stray dogs. J. Helminth. 54(4) : 299 - 301.
- Dada, B.J.O., Adegboye, D.S. and Mohammed, A.N. (1979). A survey of gastrointestinal helminth parasites of stray dogs in Zaria, Nigeria. Vet. Res. 104 (7) : 145 - 146.

- Dada, B.J.O. and Belino, E.D. (1979). Prevalence and public health significance of helminth ova in dog faeces deposited on the streets of Zaria, Nigeria. Ann. trop. Med. Parasit. 73 (5) : 495\*.
- Davies, P. and Nicholas, W.L. (1977). The helminth parasites of dogs in the Goodradigbee shire of New South Wales. Aust. Vet. J. 53(5) : 247 - 248.
- Deka, D.K., Srivastava, G.C. and Chhabra, R.C. (1981). Efficacy of three anthelmintics against experimental Echinococcus granulosus in dogs. Indian Vet. J. 58(4) : 277 - 279.
- Delak, M., Kodrnja, E., Richter, S. and Vrazic, O. (1963). Cited by Gibson (1975).
- Demidov, N.V. and Aminzhanov, M. (1975). The efficacy of hexachlorophene in the treatment of cestode infections of dogs. Veterinariya, Moscow. 6 : 69 - 70.\*
- Demidov, N.V., Matchanov, N.M. and Aminzhanov, M. (1974). An improved method for anthelmintic treatment of dogs with Echinococcus. Veterinariya, Moscow. 10 : 80-81.\*
- Dent, C.H.R. and Howkin, A.B. (1978). A survey of canine cestodes in Blayneyshire of New South Wales. Aust. Vet. J. 54 (9) : 452 - 453.
- Dent, C.H.R. and Kelly, J.D. (1976). Cestode parasites of the dog in the central table lands of New South Wales. Aust. Vet. J. 52(8) : 386 - 388.
- Dey-Harza, A. (1976). The efficacy of Droncit (praziquantel) against tapeworm infections in dogs and cat. Vet. Med. Rev. 2 : 134 - 141\*.
- Dhar, D.N., Pattnayak, S. and Basu, P.C. (1968). Prevalence of Toxocara canis infection in dogs in Delhi and experimental studies on Toxocara canis in laboratory animals. Bull. Ind. Soc. Mala. Comm. Dis. 3 : 303 - 304.
- Dorchies, P., France, H., Lahitte, J.D. De. and Berthonneau, M.C. (1980). Praziquantel treatment of taeniasis in dogs and cats. Revue Med. Vet. 131 (5) : 409 - 411. \*
- Edwards, G.T., Hackett, F. and Herbert, I.V. (1979). Taenia hydatigena and T. multiceps infections in Snowdonia, U.K.: I. Farm dogs as definitive host. British Vet. J. 135 (5) : 426 - 432.

- Ernst, S., Oberg, C. and Olivares, L. (1980). Echinococcosis in dogs in rural sector of Valdivia province. Bol. Chil. Parasit. 35 (314): 76-78.\*
- Erturk, E. and Tanzer, F. (1973). Diseases of dogs observed in Ankara in the period 1961 - 1972. Ankara Univ. Vet. Fak. Derg. 20(2/3): 277 - 280.\*
- Fernandes, B. De. F., Roesel, M. P., Nascimento, E. E. D. and Schultz (1973). On gastrointestinal parasites of the dogs diagnosed by faecal examination. Archos Biol. Tecnol. 16(2) : 126 - 128. \*
- Forbes, L. S. (1961). Notes on the incidence of Taeniidae in dogs in the North Island of New Zealand. N.Z. vet. J. 9(4) : 77-78.
- Forbes, L. S. (1963). The efficiency of N-(2'-chlor-4' nitrophenyl)-5-chlor-salicylamid against Taenia hydatigena and Echinococcus granulosus infection in dogs. Vet. Rec. 75 (12): 321 - 324.
- Fuhrmann, O. (1935). Cited by Wardle and MacLeod (1952).
- Gavrilov, A. A. (1978). Anthelmintic mixture against dog cestodes. Trudy Kazan nauchno-issled. vet. Inst. 17 : 64 - 65\*.
- Gemmell, M. A. (1957). Hydatid disease in Australia 1. Observations on the incidence of Echinococcus granulosus (Satsch 1786). Rudolphi 1805, in the dog in New South Wales. Aust. Vet. J. 31 (1) L 8 - 14.
- Gemmell, M. A. (1968). Screening of Drugs and their assessment for use against the Strobilate stage of Echinococcus. Bull. Wld. Hlth. Org. 39(1): 57 - 65.
- Gemmell, M. A., Johnstone, P. D. and Oudemans, G. (1975). The effect of mebendazole on Echinococcus granulosus and Taenia hydatigena infections in dogs. Res. vet. Sci. 19(2) : 229 - 230.
- Gemmell, M. A., Johnstone, P. D. and Oudemans, G. (1977a). The effect of niclosamide on Echinococcus granulosus, Taenia hydatigena and T. ovis infection in dogs. Res. vet. Sci. 22 (3) : 389 - 391.
- Gemmell, M. A., Johnstone, P. D. and Oudemans, G. (1977o). The lethal effect of some benzimidazoles on Taenia hydatigena in dogs. Res. vet. Sci. 23 (1) : 115 - 116.

- Gemmell, M.A., Johnstone, P.D. and Oudemans, G. (1977c). The effect of praziquantel on Echinococcus granulosus, Taenia hydatigena and T. ovis infections in dogs. Res. vet. Sci. 22 (1) : 121 - 123.
- Gemmell, M.A., Johnstone, P.D. and Oudemans, G. (1980). The effect of route of administration on the efficacy of praziquantel against Echinococcus granulosus infection in dogs. Res. vet. Sci. 29(1) : 131 - 132.
- Genchi, C., Gili, G. and Maraschin, R. (1974). Investigation of the incidence of intestinal helminths in dogs in some areas of Lombardy. Clinica vet. 97(6) : 177 - 186.\*
- Georgi, J.R. (1980). Parasitology for Veterinarians W.B. Saunders Company, Philadelphia, London. 3rd Ed. pp. 397 - 418.
- Gerin, G., Pecheur, M. and Gianfreda, H. (1980). Frequency of intestinal parasites among domestic carnivores. Annls Med. vet. 124 (2) : 133 - 136\*.
- Gibson, F.E. (1975). Veterinary Anthelmintic Medication. Common Wealth Agricultural Bureau, London. 3rd Ed. pp. 280 - 281, 285.
- Girov, G.I. (1964). Epidemiology of Echinococcus granulosus in Dagestan. Medskaya Parazit. 32 (3) : 352 - 353\*.
- Goeze, J.A.E. (1782). Cited by Wardle and McLeod (1952).
- Gomez, M.F. and Vivas, L.I. (1969). Contribucion al estudio de las parasitosis gastrointestinales de los perros. Revta. Iber. Parasit. 29 (4) : 339 - 345\*.
- Gregory, G.G. (1973). A survey of tapeworms in rural dogs in Tasmania. Aust. Vet. J. 49 (5) : 273 - 278.
- Gregory, G.G. (1977). The prevalence of tapeworms in dogs during the hydatid limitation programme in Tasmania. Aust. Vet. J. 53 (2) : 88 - 90.
- Guralp, N. and Tigin, Y. (1966). Yomesan' in kopek ve kedi cestod'larina etkisi. Vet. Fak. Derg. Ankara Univ. 13(3) : 253 - 267\*.
- Guralp, N., Tigin, Y., Oguz, T., Tinar, R. and Burgu, A. (1976a). Preliminary studies on the effect of Droncit against different tapeworms in dogs and cats. Vet. Med. Rev. 2 : 129 - 133\*.

- Guralp, N., Tigin, Y., Oguz, T., Tinar, R. and Burgu, A. (1976b). The effect of Droncit in dog and cat tapeworms. Ankara Univ. vet. Fak. Derg. 23 (1/2): 171 - 174\*.
- Gurrero, J., Pancari, G. and Micnael, B. (1981). Comparative anthelmintic efficacy of two schedule of mebendazole treatment in dogs. Am. J. vet. Res. 42 (3) : 425 - 427.
- Gyul'gyazlı, G.S. (1977). Tests with bunamidine oxynaphthoate and Droncit in intestinal cestode infections in dogs. Byull. Vseso. Inst. Gel'm. Skr. 20 : 9 - 12\*.
- Hackett, F. and Walters, T.M.H. (1980). The prevalence of cestodes in farm dogs in mid-wales. Vet. Parasitol. 7(2): 95 - 101.
- Hagedorn, K. (1974). Incidence of parasites in a small animal practice in a large city. Prakt. Tierarzt 55 (12) : 712\*.
- Hegde, K.S., Rahman, S.A., Rajasekharan, G.R. and Jaganath, M.S. (1974). A study of the incidence of hydatid disease in animals and human being in Bangalore City. Mysore. J. Agric. Sci. 8 (3) : 418 - 422.
- Himonas, C., Theodorides, J. and Priantaphyllou (1978). Investigations on the efficacy of cestocidal compounds. I. Anthelmintic activity of praziquantel against immature Echinococcus granulosus infections in dogs. Vet. Bull. 49 : 4513.
- Horen, W.P. (1957). The trichrome stain; a useful technique for staining helminths. J. Parasit 43 (6): 669.
- Hussain, M.Z. and Akhtar, A.S. (1969). Critical studies on the incidence of hydatid pathogens, Echinococcus granulosus and E. multilocularis in West Pakistan. Pak. J. Sci. 20: 100 - 106\*.
- Ibragimov, I.R. (1976). Testing phenasal and cetovex against Echinococcus, Multiceps and Taenia infections. Uchen. Zapiski. Kazanskogo Vet. Inst. im. 122 : 174 - 175.\*
- Islam, A. I.M.S. (1980). Echinococcus granulosus in dogs in Bangladesh. Am. J. vet. Res. 41 (3): 415 - 416.
- Jackson, P.J and Arundel, H. (1971). The incidence of tapeworms in rural dogs in Victoria. Aust. Vet. J. 47(2): 46 - 53.



## ABSTRACT

Five species of cestodes, viz., Dipylidium caninum, Taenia hydatigena, Echinococcus granulosus, Joyeuxiella pasqualei and Diphyllobothrium latum were encountered in dogs in Kerala, of which Dipylidium caninum was the commonest. The incidence of Dipylidium caninum was the highest in animals of the age group of above 5 years, while that of Joyeuxiella pasqualei was highest in animals of the age group of above 6 months and upto one year. Echinococcus granulosus and Taenia hydatigena were most prevalent in the age group of above 5 years. Examination of faecal samples of dogs also revealed that Dipylidium caninum was the most prevalent cestode of dogs. Albendazole at 25 mg/kg body weight, Fenbendazole at 10 mg/kg body weight, Hexachlorophene at 15 mg/kg body weight, Mebendazole at 15 mg/kg body weight repeated for 3 days, Niclosamide at 62.5 per kg body weight and Praziquantel at 2.0 mg/kg body weight could remove Taenia hydatigena completely. Fenbendazole at 20 mg/kg body weight had an efficacy of only 40% against Echinococcus granulosus. Fenbendazole at 10 mg/kg body weight, Mebendazole at 15 mg/kg body weight repeated for 3 days, Niclosamide at 125 mg/kg body weight and Praziquantel at 5 mg/kg body weight had also 100% efficacy against Dipylidium caninum.

- Kannangara, D.W.W. and Karunaratne, G.M.S. (1970). A note on intestinal helminths of dogs in Colombo. Ceylon vet. J. 18 (2): 47 - 49.
- Karasev, N.F., Nikulin, T.G. and Yanchenko, A.E. (1977). Helminths and helminthiases of dogs in the town of Vitebsk (Belorussian S.S.R). Sb. nauch. trud. leningr. vet. Inst. 48: 101 - 104.\*
- Kelly, J.D. (1975). Helminth parasites of dogs and cats II: Prevalence in urban environments in Australasia. Aust. Vet. Practitioner. 5 (3): 133 - 137.\*
- Khuddus, C.A. and Rao, N.S.K. (1971). Occurrence of two parasites of zoonotic interest in local dogs. Mysore J. Agric. Sci. 5 (2): 214 - 216.
- Kobulej, T. and Varga, I. (1978). Droncit—a milestone in the control of Echinococcus granulosus. Acta. vet. hung. 22(3): 351 - 355\*.
- Kozakiewicz, B., Pawlowski, Z. and Zatonski, J. (1975). The efficacy of niclosamide and bunamidine in the treatment of echinococcosis in dogs. Medycyna wet. 1 (8): 640 - 462\*.
- Kumar, G.M. and Sahai, B.N. (1972). A note on the incidence of helminthic infections in dogs at Patna, Bihar. Indian Vet. J. 49 (7): 737.
- Kurelec, G. and Rujavec, M. (1961). Cited by Gibson (1975).
- Leguia, G. and Guerrero, C. (1972). Prevalence of echinococcosis in dogs in Huancaayo Province, Peru. Rev. Invest. Pecuarias 1 (2) 223 - 228\*.
- Lepojevic, O., Velickovski, S. (1979). Gastro-intestinal helminths of dogs in the Skopje area of Yugoslavia, and their role in infections of man and domestic animals. Vet. Glasn. 33 (11): 893 - 896.\*
- Leuckart, K.G.F.R. (1863). Cited by Wardle and McLeod (1952).
- Leushin, N.V. (1970). Anthelmintic tested against Echinococcus and Multiceps infection in dogs. Vull. Vseso. Inst. Gelmi.SKR. 4: 85 - 86.\*

- Linnaeus, K. (1758). Cited by Yanaguta (1959).
- Lopez-Neyra, C.R. (1927). Cited by Wardle and McLeod (1952).
- Lopez-Neyra, C.R. (1928). Cited by Wardle and McLeod (1952).
- Luhe, M. (1899). cited by Wardle and McLeod (1952).
- Luhe, M. (1910). Cited by Wardle and McLeod (1952).
- Malaki, A. (1965). A survey of gastro-intestinal parasites of dogs in Bangalore with notes on some interesting observation. Indian Vet. J. 43(5): 409 - 412.
- Matchanov, N.M., Azimov, S.H.A., Oripov, A.O., Dzhumcn, Z. and Bekirov, R.E. (1977). Treatment of dogs against cestodes and nematodes. Veterinariya 1: 75 - 76\*.
- Matchanov, N.M. and Paramanova, S.K.H. (1973). Tests of phenasal and dichlorophen against cestodes in dogs. Trudy uzbek. nauchno. 20 : 84 - 86.\*
- McCristell (1971). National Hydatids Council Eleventh Annual Report and statement of accounts year ended 31, March, 1971. Hydatids Council, New Zealand. pp. 25.
- Merdivenci, A. (1968). Kopeklerde echinococcosis in yomesan'la tedavisi. Turk. vet. Hekim. Dern. Derg. 38(6) : 27 - 31\*.
- Mirzayans, A., Eslami, A.H., Anwar, M. and Sanjar, M. (1972). Gastro-intestinal parasites of dogs in Iran. Trop. Animal Health and Prod. 4 (1): 58 - 60.
- Mituch, J. (1968). Helminths of dogs in Slovakia. Folia vet. 12 (2) : 167\*.
- Moch, R.W., Fairchild, D.G., Botros, B.A.M. and Barsoum, I.S. (1974). Echinococcosis in Egypt. II. Prevalence of canine infection in the Cairo area. J. trop. Med. Hyg 77(7): 163 - 164\*.
- Mohanlal, N.S. (1932). Screening of dog faeces for ova of helminth of zoonotic importance. Dissertation for Postgraduate Diploma submitted to the Kerala Agricultural University.
- Mosky, H.E. and Harewood, P.D. (1941). Cited by Gemmell (1968).

- Mura, D. and Marceddu, L. (1972). Research on the incidence of Echinococcus granulosus of dogs of Sardinia in districts with intensive sheep breeding. Atti. Soc. Ital. Sc. Vet. 26 : 493 - 503. \*
- Nazarian, I.F. and Tabatabai, M. (1973). The prevalence of Echinococcus granulosus among dogs. Pahlavi Med. J. 4 (1) : 47 - 52\*.
- Neumann, J. and Zavadil, R. (1971). Mansonal - a preparation for treatment of taeniasis in dogs and cats. Veterinarství 21 (6) : 231 - 232\*.
- Oberg, C., Franjola, R. and Leyan, V. (1979). Helminths of dogs in Valdivia City, Chile. Boln. Chil. Parasit. 34 (1/2) : 21 - 26\*.
- Ohishi, I., Kobayashi, S. and Kume, S. (1973). A survey of canine parasites in the Tokyo area. J. Jap. vet. med. Ass. 26(5) : 223 - 233.\*
- Oripov, A.O., Bekorov, R.E. and Dzhumaev, Z. (1978). Combined method of anthelmintic treatment of dogs. Veterinariya, Moscow. 12: 60\*.
- Pal, A.K. (1970). Effect of Yomesan on tapeworms in different host species. Indian J. Anim. Hlth. 9 (1) : 115 - 116.
- Pal, M.G., Chakrabarti, A., Pramanik, A.K., Pradhan, K.K. and Chatterjee, A. (1981). Spirotrid tapeworm in mongrel dog. Indian J. Anim. Hlth. 22 (1) : 71 - 73.
- Palmieri, J.R., Thurman, J.B. and Anderson, F.L. (1978). Helminth parasites of dogs in Utah. J. Parasitol. 64(6) : 1149 - 1150.
- Panagatos, S.W. and Dunn, M.C. (1976). A survey of intestinal helminths in stray and domestic dogs of Rutherford county, Tennessee. J. Tenn. Acad. Sci. 51 (3) 97 - 99.\*
- Pandey, V.S. (1971). Observations on Echinococcosis in Bihar. Indian J. Anim. Sci. 41 (7) 596 - 599.
- Poole, T.B., Dooley, K.L. and Kollins, L.D. (1971). Efficacy of niclosamide for the removal of tapeworms (Dipylidium caninum and Taenia pisiformis) from dogs. J. Am. vet. med. Ass. 119(7) : 78 - 80.

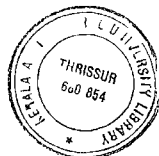
- Prakash, S., Ghose, J.N. and Varmani, B.M.L. (1969). Echinococcus granulosus infection in man and animals in and around Delhi with brief review of work done in India. Bull. Ind. Soc. Mal. Comm. Dis. 4 (3) : 174 - 182.
- Puccini, V. and Colella, G. (1979). Surveys of the incidence of Echinococcus granulosus infections in dogs in Matera Province. Nuovo Prog. Vet. 34 (22) : 1049 - 1050.\*
- Puccini, V., Lazari, P. and Sgherza, F. (1975). Survey of Echinococcus granulosus infection of dogs in Apulia, Italy. Acta med. vet. 21 (1/6) : 75 - 78\*.
- Pythal, C. (1974). Studies on cestodes of Ruminants. M.Sc. Thesis submitted to the University of Calicut.
- Rausch, R.L. and Hilliard, D.K. (1970). Studies on the helminth fauna of Alaska XLIX. The occurrence of Diphyllobothrium latum (Linnaeus, 1753) (Cestoda : Diphyllbothriidae) in Alaska, with notes on other species. Canad. J. Zool. 48(0) : 1201.
- Reddy, C.C.R.M. and Navarah, I. (1968). Epidemiology of hydatid disease in Kurnool. Indian J. med. Res. 56 (8) : 1205 - 1220.
- Reddy, P.R. (1967). Helminths of alimentary canal of dogs in Madras. M.V.Sc. Dissertation submitted to the Veterinary College, Madras.
- Rudolph, C.A. (1801). Cited by Wardle and McLeod (1952).
- Saha, B.N. (1959). A survey of the helminth parasites of stray dogs in and around Bareilly, Uttar Pradesh. Indian Vet. J. 46(3) : 734.
- Sahasrabudhe, V.K., Dubey, I.P. and Srivastav, H.O.P. (1969). Helminth parasites of dogs in Madhya Pradesh and their public health significance. Indian J. med. Res. 57(1) : 56 - 59.
- Saleh, M. and Ahmed, Z. (1965). Intestinal parasites of 200 dogs in Karachi and their potential public health significance. Z. Parasitkde. 25 (6) : 501 - 505\*.
- Sakamoto, I. (1977). The anthelmintic effect of Droncit on adult tapeworms of Hydatigera taeniaformis, Mesocestoides corti, Echinococcus multilocularis, Diphyllobothrium erinacei and D. latum. Vet. Med. Rev. 1 : 64 - 74.\*

- Sakamoto, I., Kono, I., Yasuda, W., Kitano, Y., Togoe, T., Yamamoto, Y., Iwashita, M. and Aoyama, K. (1979). Studies on anthelmintic effects of praziquantel against parasites in animals. Bull. Fac. Agric. Kagoshima Univ. 29 : 81 - 87\*.
- Saveliev, V.D. (1973). Questions of epizootology of Echinococcus granulosus and E. multilocularis in Taimyr. Sibirsk. Vestniksel'sko - khoziaistv. Nauki 18 (6) : 58 - 59\*.
- Sawyer, T.V., Congill, L.M. and Andersen, A. (1976). Helminth parasite of cats and dogs from central Utah. Gt. Basin Nat. 36 (4) : 471 - 474\*.
- Schantz, P.M., Alstine, C. von., Blecksheep, A. Jr. and Sinclair, S. (1977). Prevalence of Echinococcus granulosus and other cestodes in dogs on the Navajo Reservation in Arizona and New Mexico. Am. J. vet. Res. 38 (5) : 659 - 670.
- Schantz, P.M., Chivato, D. and Purriel, P. (1974). Discovery of Taenia ovis in a dog from the department of Flores, Uruguay. Bol. Centro Panam. Zoonosis. 16 (3) : 75 - 80\*.
- Schawalter, P. (1976). Epidemiological aspects of intestinal parasitism in dog. Schweiz. Arch. Tierh. 118 (5) : 203 - 21
- Shanta, C.S., Wan, S.F., Song, C.Y. and Kwong, K.H. (1977). A survey of the endo and ecto parasites of dogs in and around Ipoh, West Malaysia. Malaysian Vet. J. 6(3) : 95 -
- Shepelev, D.S. (1958). The distribution of Taenia hydatigena in dogs and wild carnivores. Uchen. Zapiski Vitebsk. Vet. Inst. 15 (1) : 56 - 59\*.
- Sims, M. and Sanchez, L. (1979). Echinococcus granulosus infection in dogs of Puerto Aysen and Coyhaique (XI Region, Chile). Boln. chil. Parasit. 34 (3/4) : 62 - 65\*.
- Siya, D. and Tripathy, S.B. (1981). Experimental Taenia hydatigena infection in pups in its therapy. Indian J. vet. Med. 1 (1) : 39 - 43.
- Sokolov, V.A. (1969). The helminth fauna of domestic carnivores in rural areas of Irtysh region. Trudy Omsk. vet. Inst. 24 : 151 - 153\*.
- Speckmann, G. and Webster, W.A. (1975). Natural infection and treatment of dog with Mesocestoides tapeworms. Canad. Vet. J. 16 (1) : 25 - 27.

- Stewart, G.L., Reddington, J.J. and Smyth, W.G. (1979). Intestinal parasites of dogs from Tarrant county, Texas. West. Vet. 32 (1): 29 - 32\*.
- Tassi, P., and Widenhorn, O. (1977). Research on intestinal parasites of dogs in the City of Rome. Parasitologia 19 (1/2): 43 - 57\*.
- Teichmann, P. and Grunbaum, E.G. (1964). Cited by Gibson (1975).
- Theodorides, V.J., Gyurik, R.J., Kingsbury, W.D. and Parish, R.C. (1975). Anthelmintic activity of albendazole against liverflukes, tapeworms, lung and gastrointestinal round worms. Experientia. 32 (6): 702 - 703.\*
- Thomas, H. (1977). Experimental results with praziquantel (Emoay 8440) in cestodiasis and cysticercosis. Boln. chil. Parasit. 32 (1/2) : 2 - 6\*.
- Thomas, J. and Andrews, P. (1977). Praziquantel - a new cestocide. Pestic. Sci. 8 (5): 556 - 560.
- Thomas, H. and Gonnert, R. (1978). The efficacy of praziquantel against cestodes in cats, dogs and sheep. Res. vet. Sci. 24 (1): 20 - 25.
- Todd, K.S. Jr. (1973). Albendazole in treatment of Mesocostoides corti (cestoda) infections in dogs. Vet. Med. Small Anim. Clin. 73 (4): 453 - 454.
- Unruh, D.H.A., King, J.E., Eaton, R.D.P. and Allen, J.R. (1973). Parasites of dogs from Indian settlements in north western Canada: a survey with public health implications. Canad. J. comp. Med. 37 (1) : 25 - 32.\*
- Vanparijs, O., and Thienpont, D. (1973). Anthelmintic activity of mebendazole against nematodes and cestodes in dogs. Dt. tierarztl. vscher. 80 (14): 320 - 322.\*
- Venard, C.L. (1938). Morphology, bionomics and Taxonomy of the cestode Dipylidium caninum. Ann. New York Acad. Sci. 37 : 273 - 328.
- Waitley, P.De. and Pitois, M. (1970). Notes on internal parasitism of town dogs. Cah. Med. vet. 39 : 178 - 130.
- Walters, T.M.H. and Clarkson, M.J. (1980). The prevalence of Echinococcus granulosus in farm dogs in mid-Wales. Vet. Parasitol. 7 (3) : 185 - 190.

- Wardle, R.A. and McLeod, J.A. (1952). The Zoology of Tapeworms. The University of Minnesota Press, Minneapolis. 1st Ed. pp. 392, 505 - 509, 573.
- Wikerhauser, T., Brglez, J., Kuticic, V. and Kozelj, B. (1977). The efficacy of praziquantel against immature stages of Echinococcus granulosus in dog. Parasitol. Jugoslavica 7(1): 33 - 36\*.
- Williams, B.M. (1976). The epidemiology of adult and larval (tissue) cestodes in Dyfed (U.K.). I. Cestodes of farm dogs. Vet. Parasitol. 1 (3) L 271 - 276.
- Williams, J.F., Westheimer, J. and Banman, W.R. (1975). Mesocestoides infection in the dog. J. Am. vet. med. Ass. 166 (10): 996 - 998.
- Winters, J.B. (1981). Mesocestoides corti in a dog: a case report. Vet. Med. Small Anim. Clin. 76 (1): 62.
- Yamaguti, S. (1959). Systema Helminthum Vol. II. Cestodes of Vertebrates. Interscience Publishers, INC., New York. 1st Ed. pp. 352, 436.
- Yamashita, J., Ono, Z., Takahashi, H. and Hattori (1955). On the occurrence of Echinococcus granulosus (Batsch, 1786), Rudolphi, 1805 in the dog in Rebus Island, and discussion about the course of infection of echinococcosis. Mem. Fac. Agric. 2 (3) : 147 - 150.
- Yanchev, Ya and Stoichev, I (1980). Helminths of dogs (Canis familiaris) from the Vratsa district, endemic for human nephropathy. Khelminologia. 10: 66 - 77.\*
- Yoshida, N. and Yoshida, K. (1978). Spirometra orinacei infection in dogs and cats in the basin of the Toda River, Nagoya. J. Vet. Med. 680 : 162 - 165.
- Zukovic, M., Dzakula, N., Brglez, J. and Kozelj, B. (1976). The efficacy of praziquantel (Droncit) against the tapeworm Echinococcus granulosus in the dog. Acta Parasitol. Jugoslavica. 7 (2): 75 - 77.\*

\* Reference not consulted in original.





**INCIDENCE AND TREATMENT OF CESTODES  
OF DOGS IN KERALA  
WITH SPECIAL REFERENCE TO  
THE TAENIID SPECIES**

By

**P. NARENDRAN NAIR**

**ABSTRACT OF A THESIS**

Submitted in partial fulfilment of the  
requirement for the Degree

**Master of Veterinary Science**

Faculty of Veterinary and Animal Sciences  
Kerala Agricultural University

Department of Parasitology

COLLEGE OF VETERINARY AND ANIMAL SCIENCES  
Mannuthy - Trichur

**1982**