STUDIES ON CERTAIN GASTRO-INTESTINAL NEMATODES WITH SPECIAL REFERENCE TO THOSE FOUND IN GOATS

By

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "Studies on certain gastro-intestinal nematodes with special reference to those found in goats" 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.

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31-3-1980.

V. Sathianesan

CERTIFICATE

Certified that this thesis, entitled "Studies on certain gastro-intestinal nematodes with special reference to those found in goats" is a record of research work done independently by Sri.V.Sathianesan, 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.

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31--3--1980

DEDICATED TO MY BELOVED
PARENTS AND BROTHER

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V.Sathianesan

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KEY TO LETTERING

an	:	anus
eg	:	egg
in	:	intestine
oe	:	oesophagus
oec	:	oesophageal cell
ov	:	ovary
pl	:	plug
prc	:	protein coat
re	:	rectum
sh	:	sheath
shs	:	sheath swelling
sn	:	spines
sp	:	spicule
spp	:	spicular primordium
trs	:	true shell
ts	:	testes
ut	:	uterus
vad	:	vas deferens
vg	:	vagina
vgp	:	vaginal primordium
vim	:	vitelline membrane
vl	:	vulva
yog	:	yolk granule

INTRODUCTION

INTRODUCTION

Rearing of goats is a profitable occupation of poor farmers. Hence it is only appropriate to call goat as "Poor Man's Cow". Goats provide supplementary income to marginal farmers with small investment. In our national economy goat plays an important role in view of the milk, meat, hide, hair and manure it gives. It is said that in a short period of 15 days, goat can produce as much milk as that of its body weight. Considering the above facts, almost all State Governments of Indian Union encourage goat husbandry. At present there are a number of schemes sponsored by Indian Council of Agricultural Research, in operation in various regions of India, for the development of goat husbandry. Because of these encouragements, the goat population is increasing year after year. According to the Census Reports of Kerala, the goat population has increased from 4.23 lakhs in 1951 to 16.59 lakhs in 1977.

It goes without saying that the returns from goat industry decreases by various infections. In a previous study by the author the goats in the state were found to be generally parasitised by a number of

gastro-intestinal nematodes. Biology, pathogenicity and host specificity of some of the nematodes are still obscure. The study on these aspects will go a long way in the treatment and control of these parasites. Hence the present study with the following objectives has been taken up.

1) Life history of Trichuris globulosa
2) Pathogenicity of Trichuris globulosa
3) Prepatent period of Strongyloides papillosus
4) Transmission of Neoascaris vitulorum of cattle to heterologous hosts (goats and guinea pigs)
5) Transmission of Neoascaris vitulorum to calves post-natally
6) Cross transmission of Oesophagostomum columbianum of goats to calves
7) Assessment of efficacy of anthelmintics

MATERIALS AND METHODS

MATERIALS AND METHODS

Collection of Trichuris globulosa

The worms required were collectedfrom the goats slaughtered in the Trichur Municipal slaughter house at Kuriyachira. The caeca of the animals were cut and removed after double ligaturing the open end and brought to the laboratory. In the laboratory the organ was opened and the contents transferred into a basin. The basin was then filled with water upto three fourth of its capacity and the suspension was kept undisturbed for a few minutes for settling. After complete settling of sediment the supernatent fluid was decanted. Again the basin was filled with water and the processes of settling of sediment and decanting were repeated until the supernatent was clear. Finally the worms present in the sediment were picked up by means of a camel hair brush. Worms remained attached to the caecal wall were also picked up by means of a fine forceps. The worms were then washed off the adhering dirt and debris with normal saline solution.

Culturing of eggs of Trichuris globulosa

Eggs harvested from gravid female worms were transferr into a petridish containing distilled water upto half of its capacity. The petridish was then kept covered with another larger petridish. The culture dishes were kept at room temperature. Daily, the cultures were aerated by means of a

pipette and they were examined under binocular dissection microscope for the development of larvae within the eggs.

Experimental infection with Trichuris globulosa

Ten kids, weaned at birth and reared under infection free conditions, were used for the experimental infection. At the age of two months 10,000 infective eggs were administered orally to each of the kids, by means of a feeding bottle, particular care being taken to ensure that all the eggs were administered. The animals were maintained further, under infection free conditions. Two uninfected control were also maintained under similar conditions, along with the experimental kids.

Two infection free guinea pigs were administered with 1,500 infective eggs of Trichuris globulosa from the same culture. They were also maintained under infection free conditions. One clean guinea pig was maintained as uninfected control.

Sacrificing experimental animals

Infected kids were sacrificed periodically at regular intervals of 10 and 15 days alternately. During each post-mortem the entire gastro-intestinal tract was subjected to a thorough examination. The mucosa was scraped to recover all the developmental phase of the parasite. The entire viscera was also examined to recover migratory phases if any. After recovery the worms were subjected to a thorough

morphological study.

Measurements

The measurements were taken either with the aid of an eye piece micrometer or from Camera lucida drawings. Unless otherwise stated the measurements were based on the average measurements of 50 larvae and adults and 100 eggs.

Photomicrographs

The photomicrographs were taken as far as possible of live specimens.

Prepatent period of Strongyloides papillosus

Faeces of goats naturally infected with Strongyloides papillosus was cultured in culture bottles as described by Sathianesan and Peter (1970) and the infective larvae were recovered from the culture bottles. Seven thousand infective larvae were administered orally to 6 infection free kids. Faeces of the kids was daily collected, examined and cultured from 3rd day onwards till the faeces became positive for Strongyloides papillosus eggs. Thus the prepatent period of the worm was determined.

Histopathological study

Tissues showing the lesions were fixed in 10% formalin and paraffin sections were taken at 5 - 8 microns thick using conventional process. Haemotoxylin and Eosin staining

method was used for studying tissue changes.

Haematological study

After completion of the prepatent period of Trichuris globulosa, blood samples were collected from both infected and control goats at intervals of one week for 3 occasions and these samples were subjected to various haematological tests. In this way ESR, PCV, haemoglobin, MCV, MCHC, RBCs and WBCs were estimated by adopting the standard methods.

Transmission of Neoascaris vitulorum in heterologous hosts (goat and guinea pig)

Neoascaris vitulorum voided through faeces of naturall infected calves were collected and washed off their debris and dirt with water and then with normal saline solution. Eggs from mature female Neoascaris vitulorum were harvested by dissecting them. These eggs were then transferred into a culture dish containing 0.1% formalin. The culture was examined daily for the development of larvae. When the larvae were fully developed 20,000 infective eggs were administered to pregnant goats. These goats were further maintained under careful infection free laboratory conditions. Extreme care was taken in giving them clean feed and well washed fodder. When the goats gave birth to kids, faeces of these kids were periodically examined for the presence of N. vitulorum eggs.

Guinea pigs reared under infection free conditions

were administered with 2000 infective Neoascaris vitulorum eggs. The faeces of these guinea pigs was examined periodically for determining whether the worms has attained maturity. The guinea pigs were ultimately destroyed to note the developmental phases, if any, present.

Transmission of Neoascaris vitulorum to calves post-natally.

Egg cultures set up with eggs from Neoascaris vitulorum collected from naturally infected calves were used for setting up experimental infection. Two calves weaned at birth were administered with these egg cultures (about 50,000 eggs) before the first colustrum feeding and they were kept under infection free conditions. From the 4th week after infection, their faeces was examined for N. vitulorum eggs at weekly intervals upto a period of 2 months. Finally the calves were sacrificed for detailed post-mortem examinations.

Transmission of Oesophagostomum columbianum from goats to cattle

Infective 3rd stage larvae of Oesophagostomum columbianum were raised in the laboratory by culturing the eggs harvested from female worms collected from naturally infected goats. These larvae were administered to 2 calves at the rate of 50,000 larvae per calf. The calves were maintained under laboratory conditions. One clean goat was also simultaneously infected with 10,000 larvae from the same culture to test the

viability of the culture. The animals were screened for infection by conducting faecal examination daily from the 4th week after infection upto a period of 8 weeks.

Assessment of efficacy of anthelmintics

a) Against Trichuris globulosa

Experimental infection was set up in 15 clean kids with Trichuris globulosa. When the prepatent period of the worm was reached, as determined by faecal examination, the animals were divided at random into 5 groups of 3 each. Faecal EPG of all the animals was determined daily for 3 days before medication and then they were medicated with different anthelmintics. First group was given Oxibendazole @ 10 mg/kg body weight, second group was given thiophanate @ 50 mg/kg body weight, the third group was given Albendazole @ 10 mg/kg body weight, the fourth group was given Parbendazole @ 30 mg/kg body weight and the last group was maintained as untreated control group. On 5th day the EPG of all the animals were taken and the percentage of elimination was calculated on the basis of pre treatment and post-treatment values of EPG.

Efficacy of the anthelmintics at double the recommended dose against Trichuris globulosa was also determined in the same way, when complete clearance was not obtained with the usual recommended dosage.

b) Against common strongyles.

Experimental infection was set up in 25 clean goats with Haemonchus contortus, Trichostrongylus colubriformis, Bunostomum trigonocephalum, Oesophagostomum columbianum, O. asperum and Strongyloides papillosus by administering the infective larval cultures (containing equal number of larvae) of the respective worms. The cultures were obtained by culturing the faeces of donor animals with monospecific infections. After 85th day of infection (B. trigonocephalum has the longest prepatent period of 85 days) all animals were randomly selected and separated into 5 groups of 5 each. The animals were weighed individually for the purpose of medication. The Ist group was administered with Oxibendazole @ 10 mg/kg body weight, the IInd group was administered with thiophanate @ 50 mg/ kg body weight, the IIIrd group was administered with Albendazole @ 10 mg/kg body weight, the IVth group was administered with Parbendazole @ 30 mg/kg body weight and the Vth group was maintained as untreated control group. On 5th day one animal from each group was sacrificed and the worms including the immature forms were collected by a thorough post-mortem examination. By a comparison of the number of worms obtained from treated and untreated groups of animals the efficacy of the anthelmintic was determined.

Influence of anthelmintic medications on the weight gain of treated goats

All the goats infected with common strongyles as mentioned supra were used for this purpose. All the kids were weighed before medication to note their pre treatment weight. Subsequent to medication, the animals were reweighed at the end of 30 days (excepting the kids which were sacrificed for assessing the efficacy of drugs). By a comparison of pre-medication and post medication weights the influence of each anthelmintic on the weight gain of treated goats was calculat

In vitro study on the efficacy of anthelmintics

Suspensions of 1: 10,000 of Oxibendazole, Nemafax (thiophanate), Parbendazole and Albendazole were prepared and aliquots of 5cc were taken in separate petri dishes. In a control petri dish 5cc of plain aquarium water was kept. Freshly collected 5 male and 5 female Haemonchus contortus w were introduced into each petri dish simultaneously and were examined under a binocular dissecting microscope at 1 hour interval. Time required for complete immobility or death of the worms in each petri dish was determined. By comparin the time taken by each anthelmentic solution to exert a leth effect on the worms, the efficacy of the anthelmintics was determined.

The methods and techniques other than those furnished supra are given in the appropriate sections.

LIFE CYCLE OF *TRICHURIS GLOBULOSA* AND EXPERIMENTAL *TRICHURIS* INFECTION IN GUINEA PIGS

Fig. 1. Trichuris globulosa
mature egg (drawing)

Fig. 2. Trichuris globulosa
egg-morula stage (Photomicrograph)

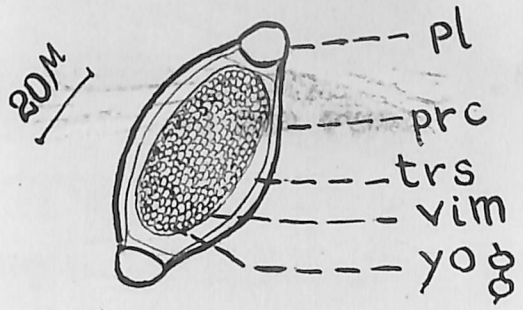


Fig. 1

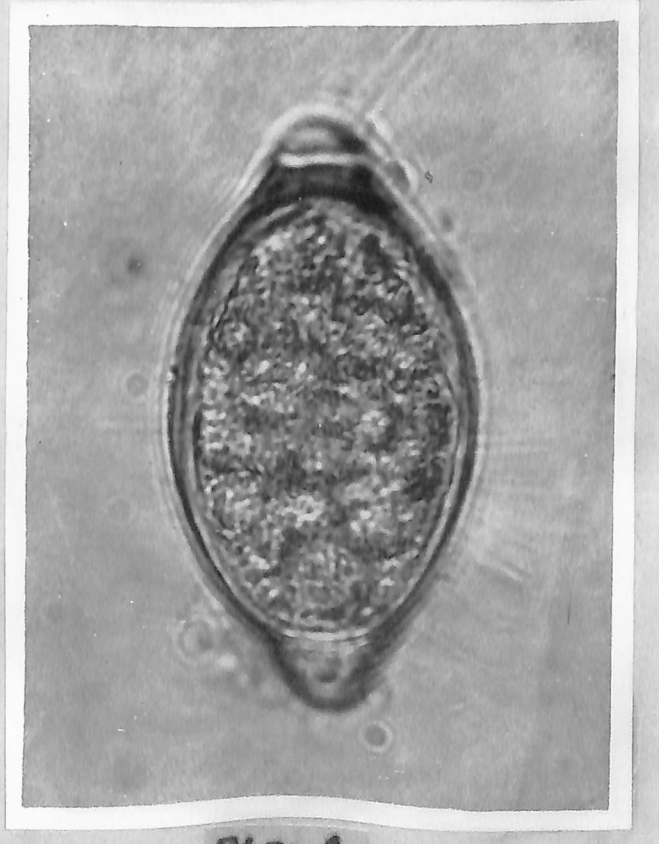


Fig. 1.

LIFE CYCLE OF TRICHURIS GLOBULOSA (V. LINSTOW, 1901)

Lifecycle of Trichuris globulosa has not been worked out earlier. But the life cycle of T. ovis - a closely related species had been determined by many workers (Thapar and Singh, 1954; Deo, 1960; Dalchow, 1964; and Ustinov, 1973).

Characters of the egg (Figs. 1,2 & 3)

The eggs of Trichuris globulosa were barrel-shaped, double plugged and dark brown when laid. The uterine eggs were not so deeply coloured. They measured 0.067 - 0.071 mm. in length by 0.03 - 0.032 mm. in width at the middle. The embryo was unsegmented and contained numerous yolk granules. There were 3 layers of egg shell. The outer most was the protein coat, immediately inside was the true shell and the innermost was the vitelline membrane covering the yolk contents.

Egg culture

Different media were used for cultural studies. They were (1) aquarium water (2) 0.5% formalin (3) water with washed cattle dung fibres and (4) aerated distilled water.

In aquarium water and 0.5% formalin there was development of the eggs. In the former, the larvae appeared in

eggs on the 16th day and in the latter on 17th day. The keeping quality of the culture was poor for both the media. In cattle dung fibre medium, no development of eggs could be noticed. Aerated distilled water was found to be the best medium, since the keeping quality was good. In that medium the larvae completed their development on the 15th day. The larvae were motile at first and gradually become quiescent. They remained viable for 7 months under laboratory conditions.

In vitro hatching of infective eggs of Trichuris globulosa

The infective eggs of T. globulosa were incubated for 24 hours at room temperature in artificial gastric juice (Artificial gastric juice was prepared by dissolving 0.6 g of pepsin in 1.3 cc of concentrated hydrochloric acid. To this was added distilled water to make the total volume to 100 cc). The eggs did not hatch in this medium. But they could be pressure hatched under a cover slip. When pressur was applied one of the plugs gave way for the larvae to emerge out.

Infective larva (Fig. 4)

The larva released from egg mechanically was not active. It measured 0.175 mm. in length. Maximum width at the anterior end was 0.015 mm. and at the distal end 0.01 mm. Except at the tips which were tapering, the body

Fig. 3. Trichuris globulosa
embryonated egg containing
larva (Photomicrograph)

Fig. 4. Trichuris globulosa
Infective larva pressure
hatched (Photomicrograph)

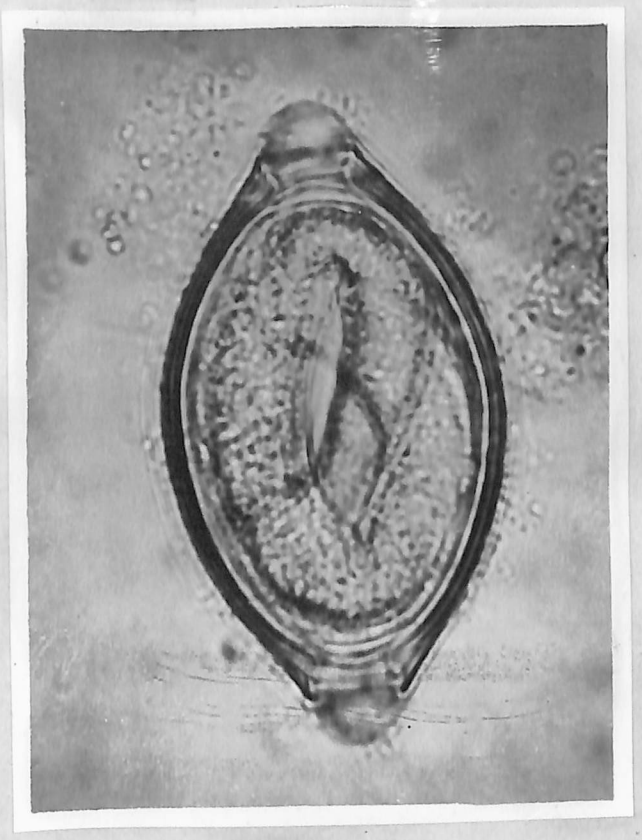


Fig. 3.

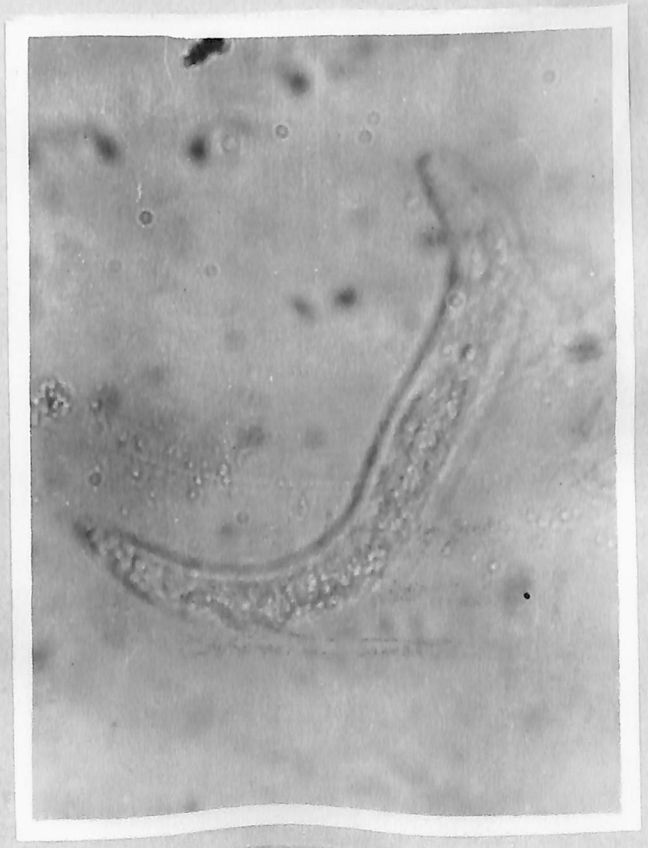


Fig. 4.

was uniformly thick through out its length. Oesophagus was 0.085 mm. in length. The intestine was indistinct and was represented by a mass of granular cells.

Infection experiments in kids

Twelve kids from the Goat Project were made available for this purpose. Their tattoo numbers were 301, 303, 447, 460, 467, 476, 478, 480, 488, 489, 495 and 499. They were weaned at birth and reared in the experimental animal sheds of the college, free of infection. They were fed according to the feeding standards. In the very young age they were given goats milk which was boiled and cooled. Gradually concentrates and washed jack leaves were introduc into the ration and the milk was proportionately reduced. Their faeces was periodically examined to make sure that they were maintained free of infection. At the age of 2 months 10 of them were infected with infective eggs of Trichuris globulosa and the remaining 2 were maintained as uninfected control. Infective eggs suspended in aquarius water were administered with a feeding cup. After administering the entire infective materials the cup was rinsed with a little water and the washed fluid was also administered. The kids were periodically sacrificed to study the stage-to-stage development of the parasite. The detail of the infection experiments are furnished in table, 1.

Table 1.

Experimental data on Trichuris globulosa infection experiments in kids

Sl. No.	Tattoo number of kids	Number of infective eggs administered	Date of infection	Date of sacrifice.	Date of appearance of eggs in faeces
1	301	10,000	24-12-1976	10th day	
2	460	"	"	25th day	
3	303	"	"	35th day	
4	433	"	"	50th day	
5	476	"	"	60th day	
6	430	"	"	81st day	
7	467	"	"		85th day
8	470	"	"		89th day
9	439	"	"		95th day
10	495	"	"		96th day
11	447	"	"	Uninfected control	
12	499	"	"	Uninfected control	

Fig. 5. Trichuris globulosa
10 days old larva-entire
(Photomicrograph)

Fig. 6. Trichuris globulosa
25 days old larva-anterior end
(drawing)

Fig. 7. Trichuris globulosa
25 days old larva-posterior end
(drawing)

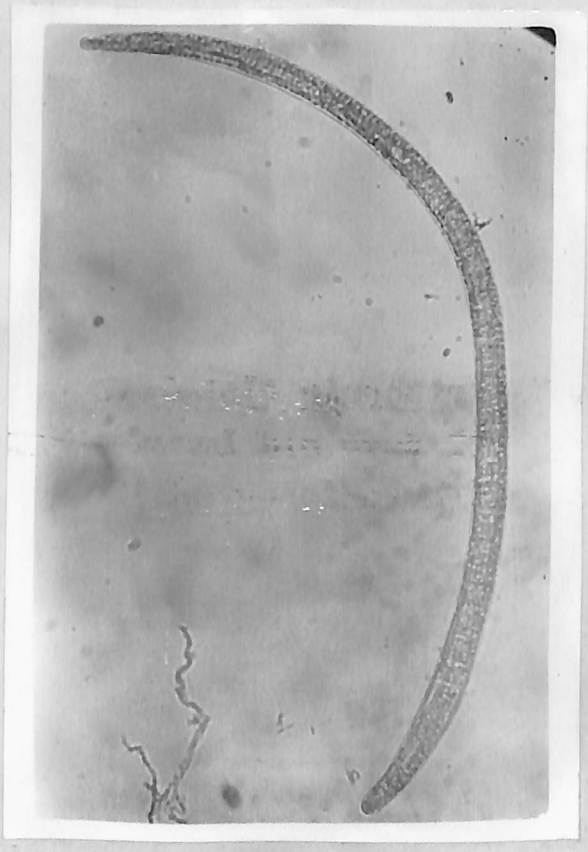


Fig. 5

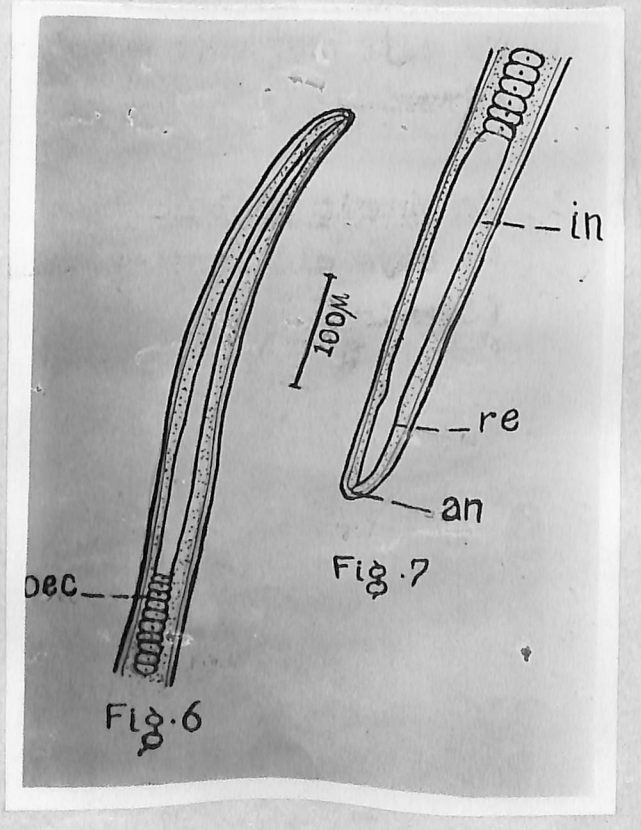


Fig. 6

Fig. 7

10 days old larva (Fig. 5)

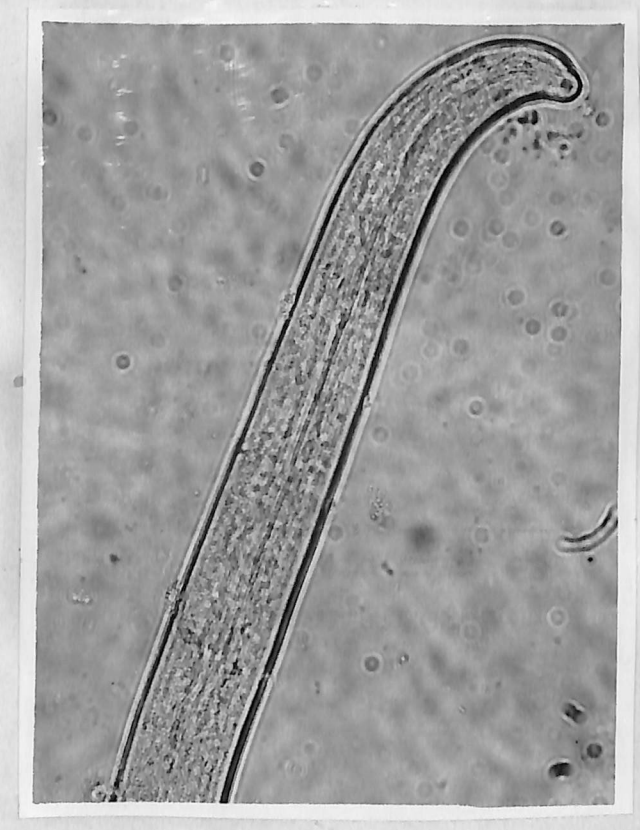
Kid killed 10 days after infection showed larvae both in caecum and small intestine. Majority of the larvae were in caecum. Only a small percentage were in small intestine. Average measurements of the juveniles were as follows. Length 2.425 - 3.196 mm., width at the anterior end 0.01 mm. and at the posterior end 0.018 mm., the oesophagus 2.068 - 2.538 mm. in length, the intestine 0.203 - 0.470 mm. long and the rectum 0.094 - 0.188 mm. long. The body was almost uniformly thick through out its length.

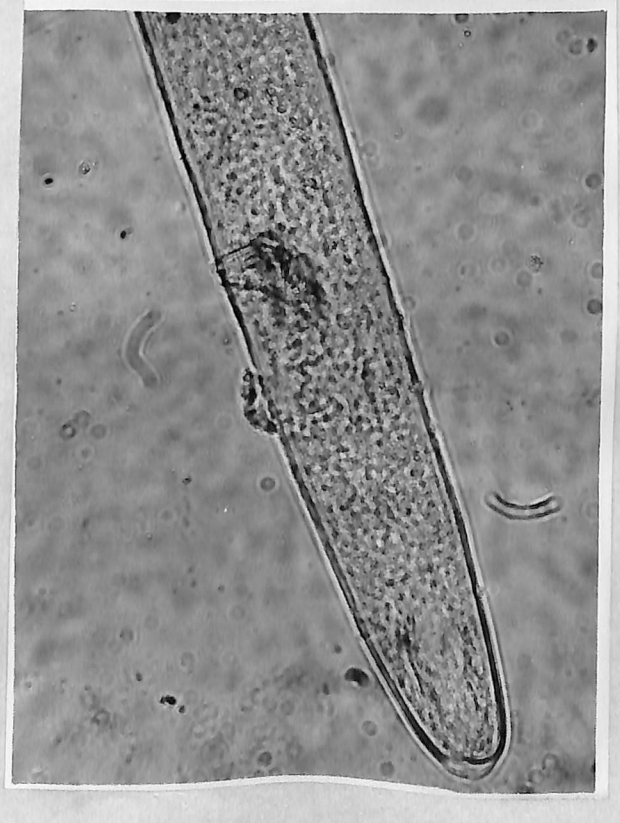
25 days old larva (Figs. 6,7,8,9 & 10)

On 25th day post-infection all the juveniles were present free in the lumen of the caecum. No larvae were present in any other situations. Caecal scrapings when examined under binocular microscope, showed that excepting a few, most of the larvae were inactive. Those that were active showed twisting and curling movements. The larvae measured as follows. Length 2.556 - 3.760 mm., width at the anterior end 0.01 mm. and at the posterior end 0.018 mm., oesophagus 2.068 - 3.102 mm. long, length of intestine 0.376 - 0.470 mm. and the rectum 0.112 - 0.188 mm. long.

Fig. 8. Trichuris globulosa
25 days old larva-anterior end
(Photomicrograph)

Fig. 9. Trichuris globulosa
25 days old larva-posterior end
(Photomicrograph)





35 days old larva (Figs. 11 & 12)

On the 35th day post infection the larvae were present in the posterior end of ileum, in the caecum and in the anterior end of colon. More than 50% of the larvae recovered, were from the caecum, about 20% from the ileum and the rest from the colon. In all the situations the larvae were present both in the contents and in the scrapings of the organ. The scrapings contained comparatively more number of larvae. However no larvae were seen embedded into the caecal wall. Many of the juveniles remained coiled but none showed any active movements. The sexes were indistinguishable. The larvae measured 6.956 - 8.422 mm. in length with 0.01 mm. width at the anterior end and 0.018 mm. width at the posterior end. The length of the oesophagus 5.734 - 7.144 mm., length of intestine 0.94 - 1.028 mm., rectum 0.152 -0.220 mm. long.

50 days old larva (Figs. 13, 14 & 15)

On the 50th day post-infection the larvae were present in the posterior end of the ileum, in the lumen of the caecum and in the anterior end of colon. Majority (about 60%) were in the caecal scrapings, about 15% were in the ileum and the rest were in colon. The larvae were not

Fig. 10. Trichuris globulosa
25 days old larva- entire
(Photomicrograph)

Fig. 11. Trichuris globulosa
35 days old larva-anterior end
(Photomicrograph)

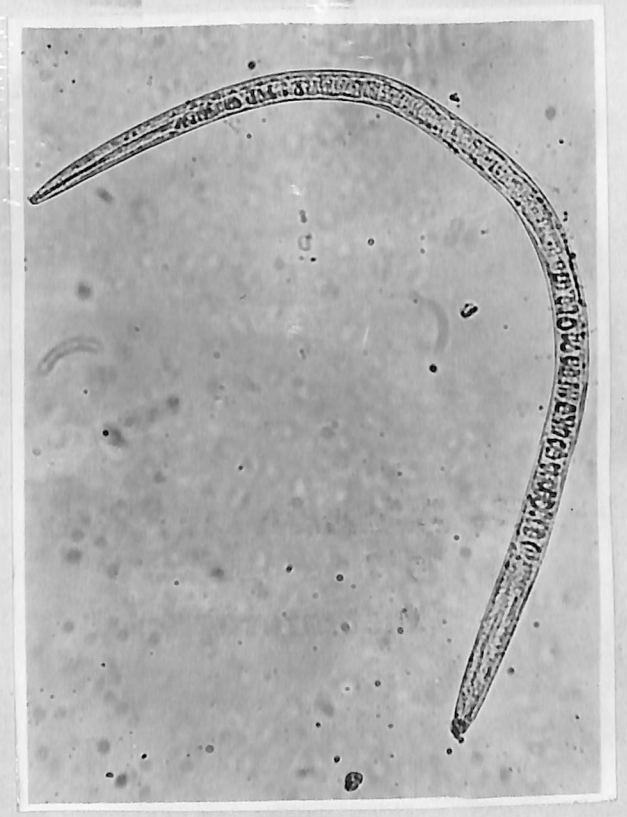


Fig. 10.

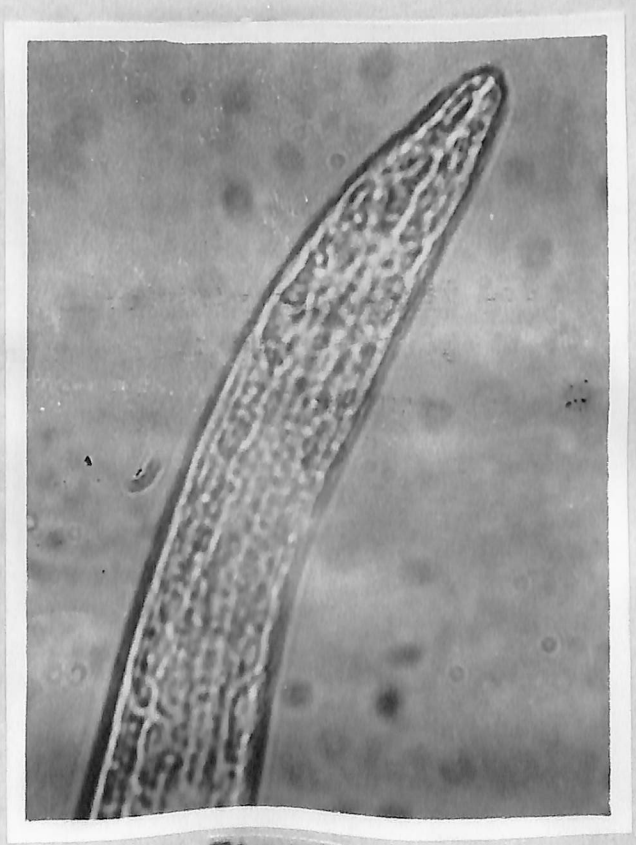


Fig. 11.

embeded into the caecal wall as with larvae of 35 days. Majority of the larvae were inactive. Some of them remained spirally coiled. Though the sexes were not readily distinguishable the spicular and vaginal primordia could be distinquished in some of the larvae. The larvae showed wider variations in their size. Smaller larvae with a size not more than that of 35 days old were also present. Various measurements of the larvae were as follows. Length 7.641 - 15.134 mm., width at the anterior end 0.016 mm. and at the posterior end 0.037 mm., length of oesophagus 6.71 - 11.28 mm., intestine 1.306 - 3.384 mm. in length and rectum 0.225 - 0.470 mm. long.

60 days old larva (Figs. 16, 17, 18, 19 & 20)

On 60th day, caecum and colon alone contained the larvae. Majority of the larvae were in the caecum. Unlike the larvae of earlier stages the anterior extrinities of the 60 days old juveniles were deeply embeded into the caecal mucosa. The scraped out larvae showed active movements. Some of them were curled up. The colour of some of the larvae was slightly brownish. The sexes were still not readily distinguishable. But the sexual organs had attained further development. The juveniles measured 14.6 - 19.2 mm. in length. The width at the anterior end 0.013 mm. and the at the posterior end 0.094 mm., oesophagus meas-

Fig. 12. Trichuris globulosa
35 days old larva-posterior end
(Photomicrograph)

Fig. 13. Trichuris globulosa
50 days old larva-anterior end
(Photomicrograph)

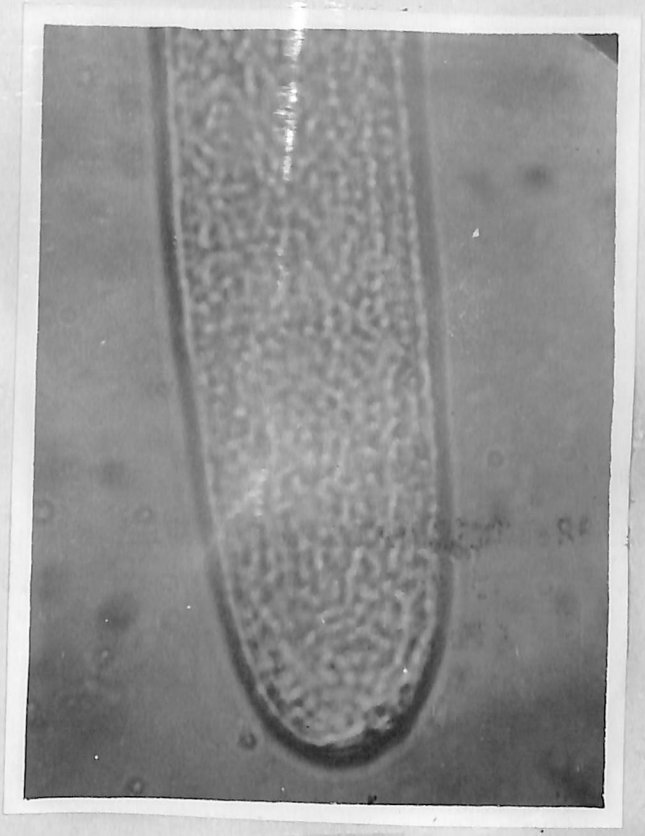


Fig. 12.

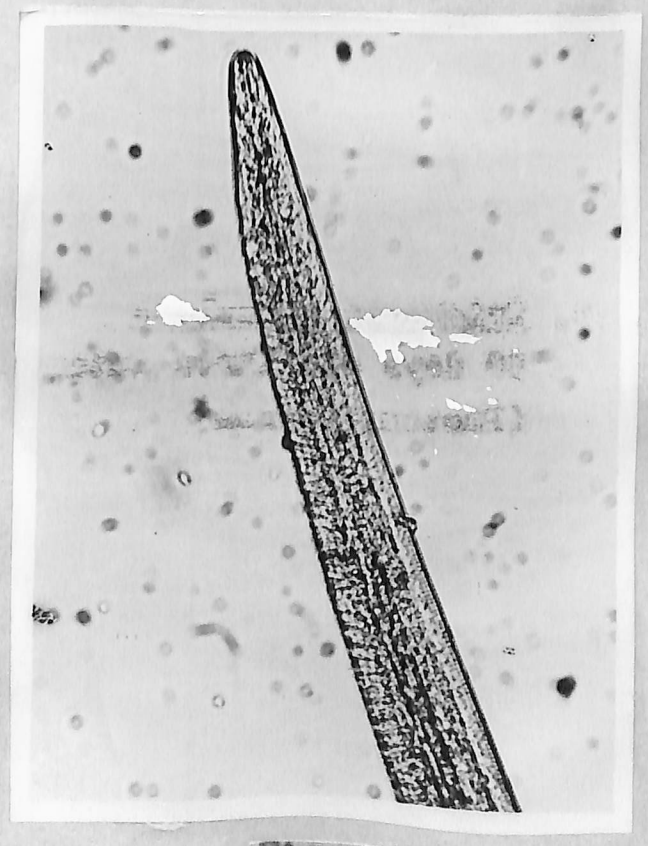


Fig. 13.

ured 12.2 - 15.1 mm. in length, intestine 2.3 - 3.8 mm. long and the length of rectum 0.188 - 0.376 mm.

81 days old juvenile (Figs. 21, 22, 23, 24, 25 & 26)

Large number of almost mature worms were found firmly attached to the caecal wall. A mouth collar was present at the anterior end of the worm. The sexes were readily distinguishable. Even as the worms have attained sexual maturity, no actual larval moultings could be observed from the time the infective larvae were given to the kids till 81st day. As mentioned supra the infected animal were sacrificed at the following periods; 10days, 25 days, 35days, 50 days 60 days and 81 days. Measurements of the worms on the 81st day were as follows:-

Male

Body 48.08 - 52.42 mm. long, the mouth collar 0.049 x 0.016 mm. in size, width at the anterior end 0.358 mm., oesophagus 32.6 - 34.8 mm. long, intestine 13.854 - 15.88 mm. in length and rectum 1.526 - 1.74 mm. long. The posterior end was spirally coiled with a sheath which was 0.619 - 0.723 mm. in length. The sheath enclosed a spicule which was either protruded or retracted. A globular swelling was invariably present in the sheath. The sheath and the swelling were studed with

Fig. 14. Trichuris globulosa
50 days old larva-spicular primordium (Photomicrograph)

Fig. 15. Trichuris globulosa
50 days old larva-vaginal primordium (Photomicrograph)

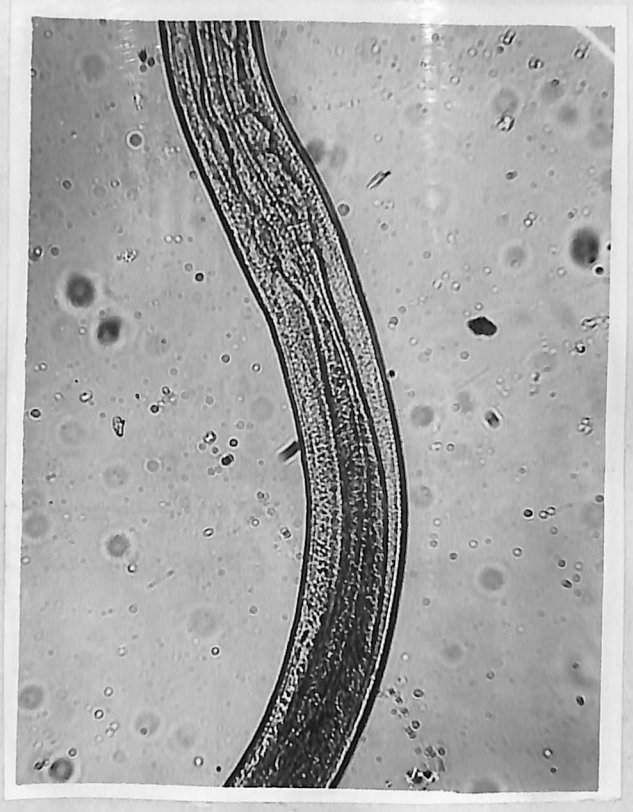


Fig. 14

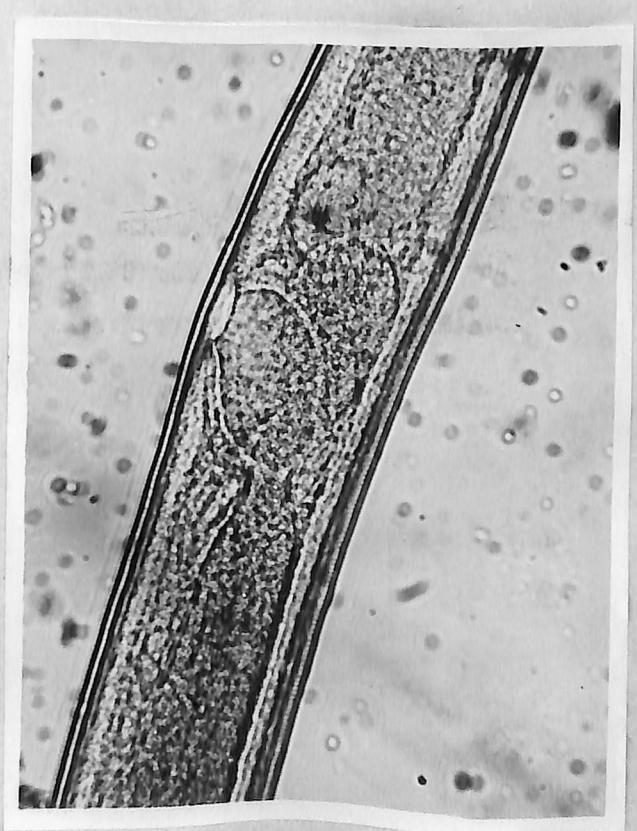


Fig. 15.

numerous spines. The spines on the swelling were larger than those on the rest of the sheath.

Female

Body 39.527 - 42.625 mm. long. Maximum width at the anterior end 0.016 mm. and that at the posterior end 0.489 mm., mouth collar 0.032 x 0.016 mm., oesophagus 28.851 - 30.183 mm. long, intestine 9.291 - 10.839 mm. in length and rectum 1.385 - 1.603 mm. long. The posterior end was slightly curved in the form of a hook. The femal did not contain any mature eggs.

Prepatent period

After 81 days, faecal examination was carried out daily to find out the prepatent period. In goat numbers 467 and 489 the faeces became positive on the 85th day. In goat numbers 495 and 478 the faeces became positive on the 86th day and 89th day respectively. Hence the pre patent period varied from 85-89 days in experimentally infected kids. The goats continued to be positive for more than one year. Uninfected control remained negative throughout the experiment.

Description of adult worms (Figs. 27, 28 and 29)

The body was distinctly divided into a slender and longer anterior or oesophagial region and a stouter and

Fig. 16. Trichuris globulosa
60 days old larva-male-
posterior end (drawing)

Fig. 17. Trichuris globulosa
60 days old larva-female-
vaginal region (drawing)

Fig. 18. Trichuris globulosa
60 days old larva-female-
posterior end (drawing)

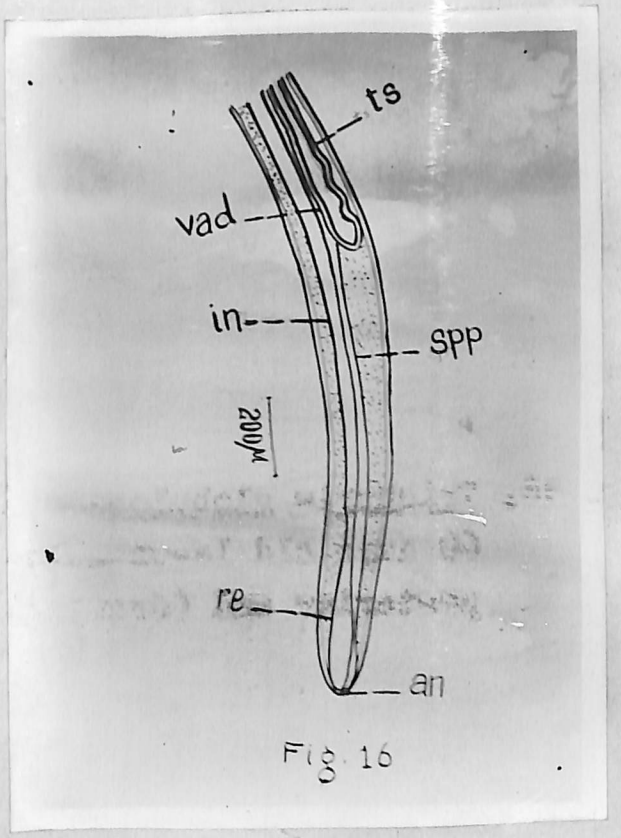


Fig. 16

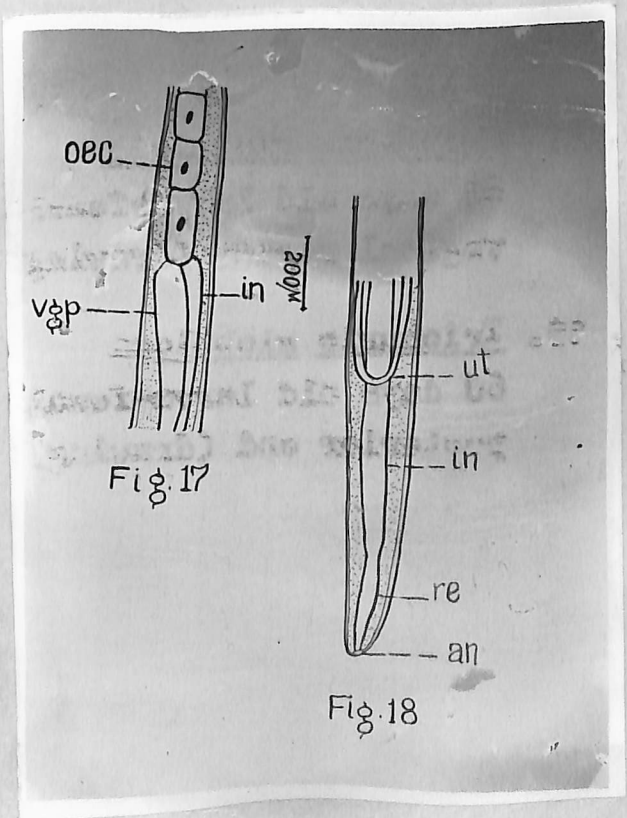


Fig. 17

Fig. 18

shorter posterior region. The length of oesophagus varied from more than 1/2 to 3/4th of the total body length. The sexes were readily distinguishable as the posterior end of the male was strongly coiled up while that of the female was gracefully curved. The male to female ratio was 1 : 1.4. The worms were white in colour. The body cuticle was striated and the striations were set 0.005 mm. apart. There was a distinct mouth collar of 0.037 x 0.018 mm. in size.

Male

Body 58.2 - 68.8 mm. long, thickness at the anterior end 0.018 mm. and at the posterior end 0.188 mm. The maximum thickness was at the middle of the posterior portion where it varied from 0.6 - 0.7 mm. Other measurements were:- oesophagus 37.6 - 45.68 mm. in length, intestine 18.8 - 21.2 mm. long, rectal length 1.88 - 1.92 mm., spicule 4.2 - 4.7 mm. long, width of the spicule at the proximal end 0.037 mm. and at the distal end 0.018 mm., spicule sheath contractile, when everted 1.034 - 1.28 mm. long by 0.094 - 0.098 mm. wide, distal swollen part 0.30 - 0.38 mm. in diameter. The sheath and the sheath swelling showed numerous spines. The spines on the swelling were 0.023 mm. long while those on the rest of the sheath were 0.008 mm long. The single testis extended

Fig. 19. Trichuris globulosa
60 days old larva-male-
posterior end (Photomicrograph)

Fig. 20. Trichuris globulosa
60 days old larva-female-
vulval region (Photomicrograph)

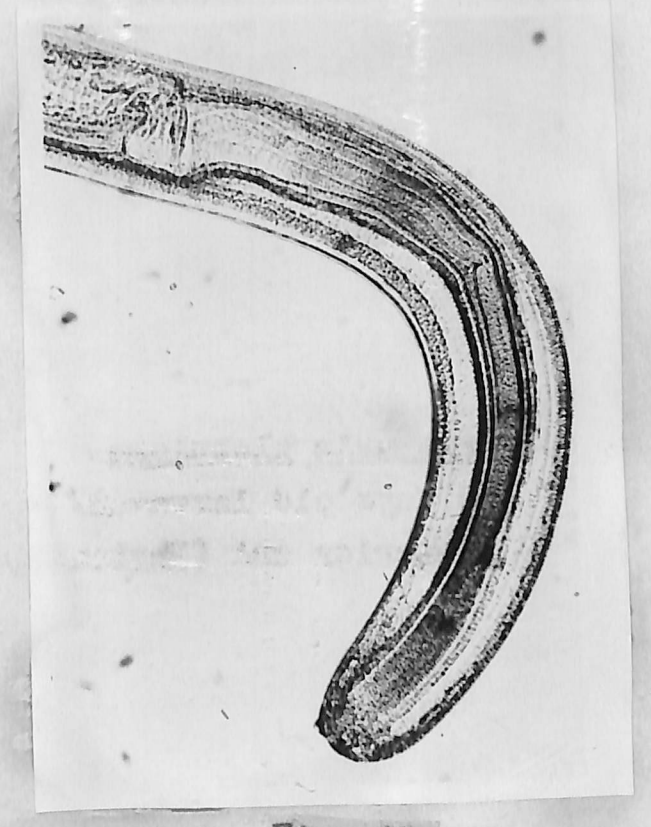


Fig. 19.

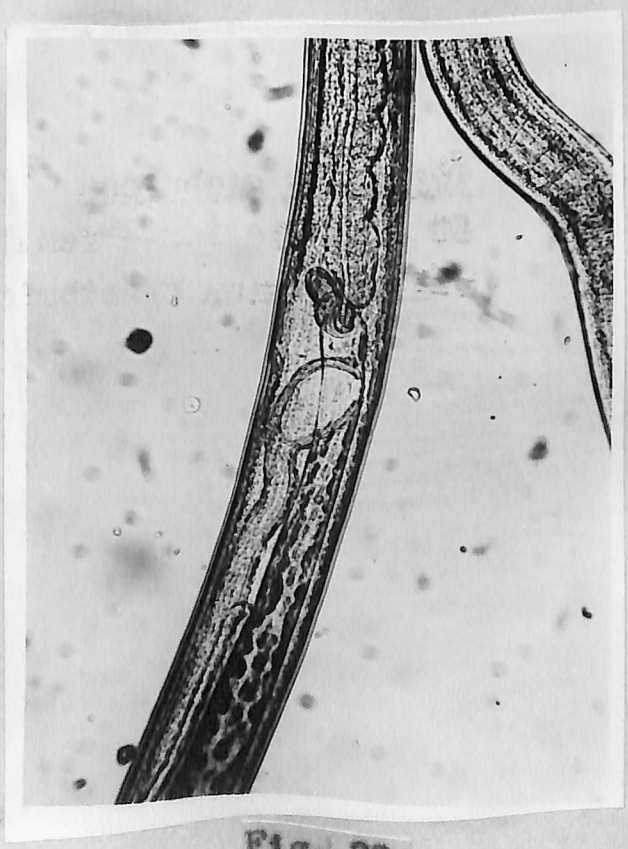


Fig. 20.

Fig. 21. Trichuris globulosa
81 days old-juvenile-male
tail end (drawing)

Fig. 22. Trichuris globulosa
81 days old juvenile-female-
vulval region (drawing)

Fig. 23. Trichuris globulosa
81 days old juvenile-female-
posterior end (drawing)

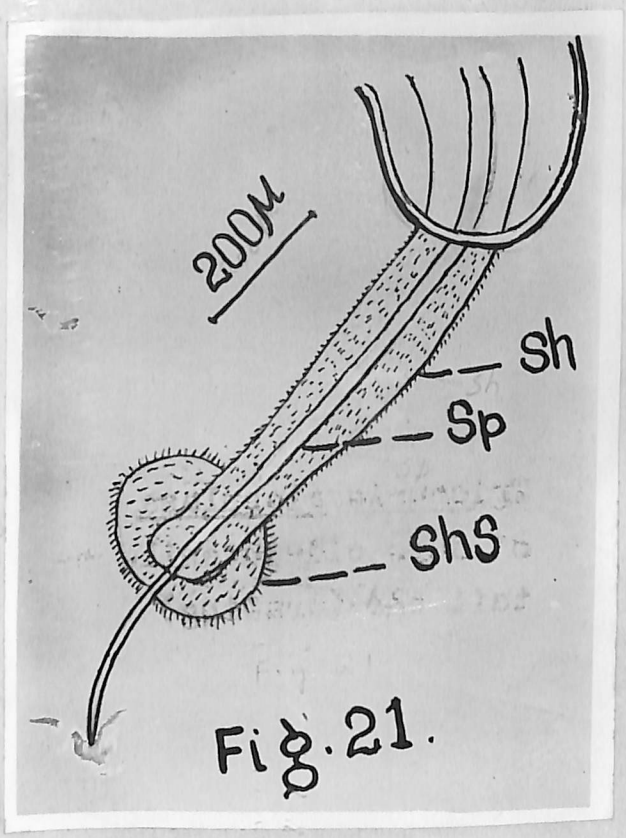


Fig. 21.

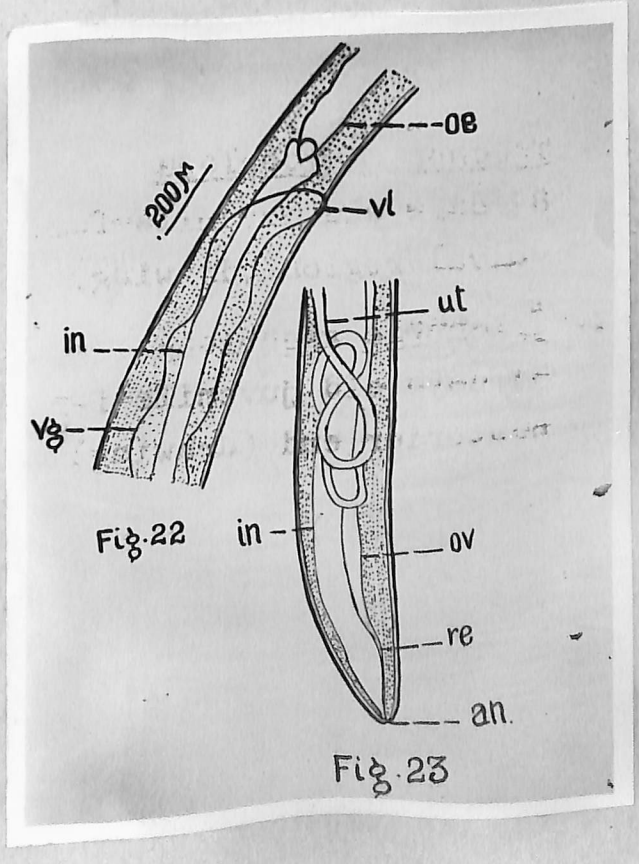


Fig. 22

Fig. 23

from the intestino-rectal junction to the oesophago-intestinal junction, where it was reflexed back as vasdeferens and ended in an ejaculatory duct.

Female

Body 52.4 - 61.6 mm. long, the maximum thickness was in the middle of the posterior portion where it varied from 0.798 - 0.875 mm., the length of oesophagus 37.6 - 44.1 mm., intestine 14.8 - 16.92 mm. in length, rectum 0.481 - 0.564 mm. long. The vulva was at a distance of 0.305 - 0.344 mm. from the posterior end of oesophagus and it was indicated by a depression on the body wall. The distal portion of the vagina was lined internally with a large number of coarse spines. The vagina at a short distance posterior to the spiny area expanded to form a large egg reservoir. The latter was followed by the uterus which ended in the oviduct. The oviduct turned forward at a short distance from intestino-rectal junction and extended to the oesophago-intestinal junction where it joined with the ovary. The ovary terminated a little anterior to the anus which was located at the posterior end of the worm. The anal region was bluntly rounded.

Fig. 24. Trichuris globulosa
81 days old juvenile-anterior end
with mouth collar (Photomicrograph)

Fig. 25. Trichuris globulosa
81 days old juvenile-female-
vulval region (Photomicrograph)

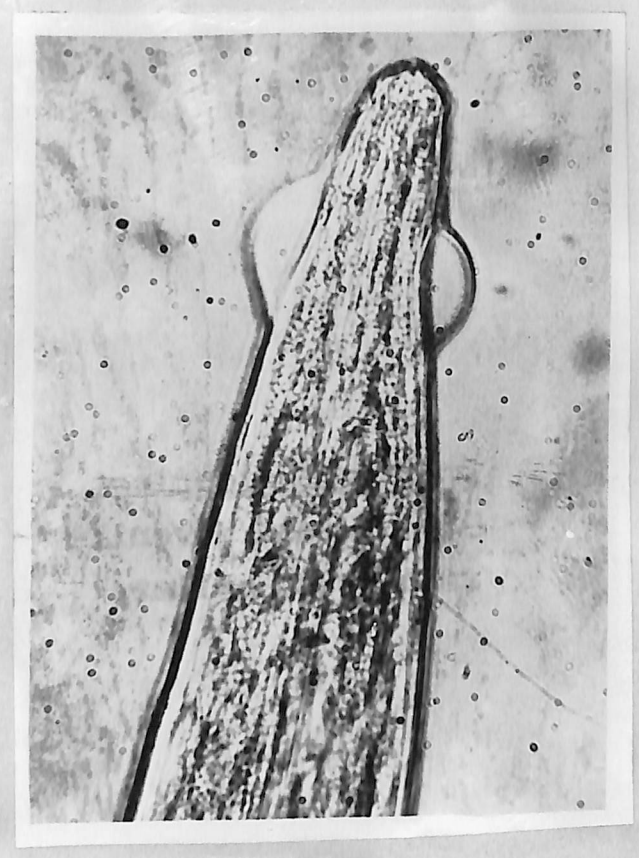


Fig. 24.

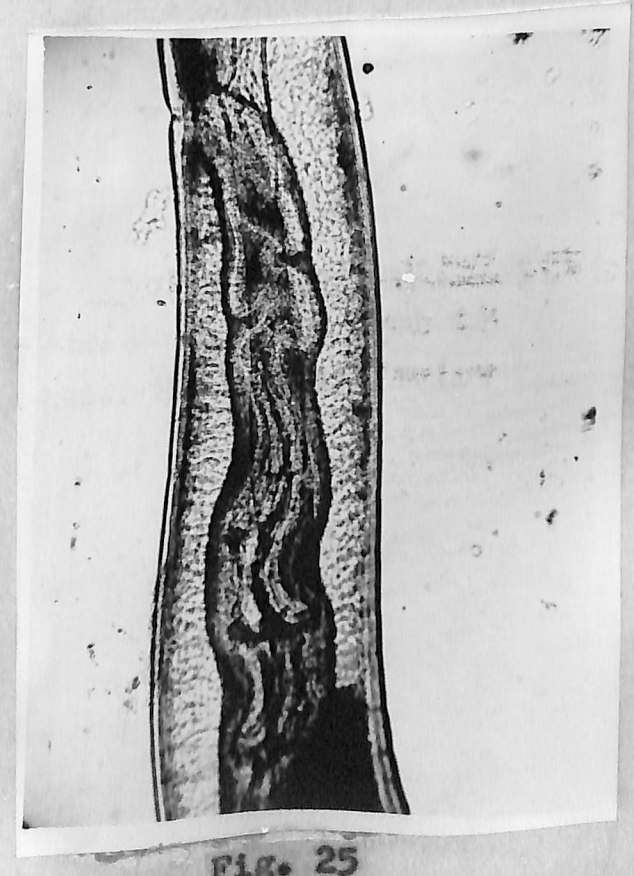


Fig. 25

DISCUSSION

According to the present findings, fully developed larvae formed inside the eggs in 15 days at a room temperature of 27 - 31°C. But Thapar and Singh (1954) while working with Trichuris ovis obtained fully developed embryo in the eggs cultured in distilled water in 21-22 day at 80-82°F (26.6 to 27.7°C). Deo (1960a) obtained infective larvae of T. ovis at a temperature of 35.5°C in aerated distilled water. Dalchow (1964) obtained 1st stage larvae in 15-17 days at 32°C in aerated distilled water. Dalchow (1964) obtained 1st stage larvae in 15-17 days at 32°C. According to Puchow (1939) 24-25 days were needed for the development of 1st stage larvae at a temperature of 25-30°C Artyukh (1956) found that the eggs of T. ovis embryonated in 16 days at 30°C. The present findings also agrees with those of previous workers referred to above. According to Deo (1960 a) the optimum temperature for embryonation of T. ovis eggs was 35.5°C. But according to Powers (1961) the optimum temperature for embryonation was 32°C and at that temperature, he found the first stage larvae to appea from 13-15 days. In the present findings however, the optimum temperature for embryonation of eggs of T. globulo was found to be 27-30°C.

Deo (1947) found aerated distilled water to be the

Fig. 26. Trichuris globulosa
81 days old juvenile-female
posterior end (Photomicrograph)

Fig. 27. Trichuris globulosa
Adult male-posterior end
(drawing)

Fig. 26.

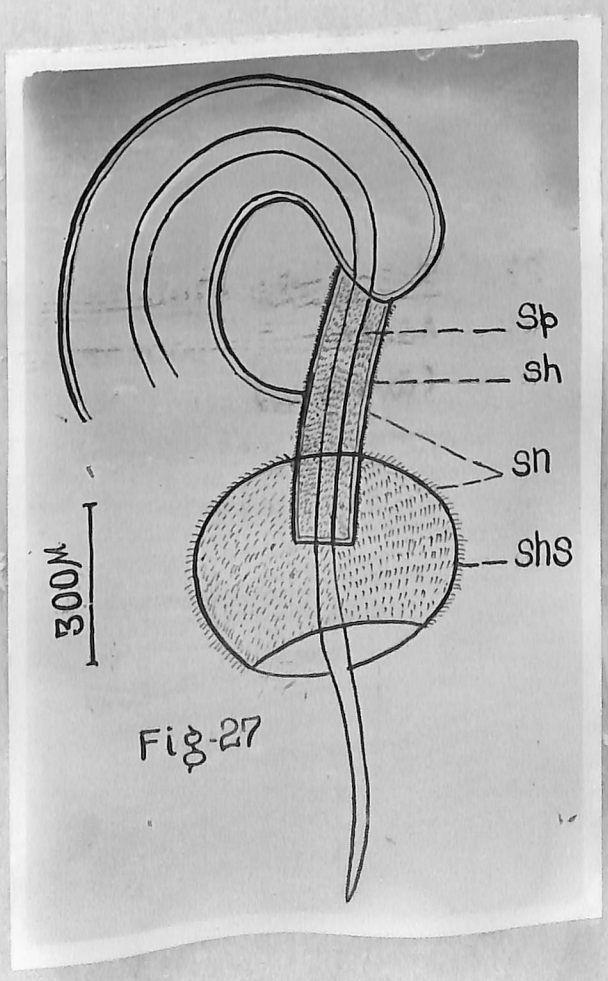


Fig-27

best medium for the development of T. ovis eggs, which is confirmed in the present findings, for T. globulosa eggs also.

Although Deo (1960 a) obtained hatching of embryonate eggs in artificial gastric juice the percentage of hatching was as low as 4%. In the present studies spontaneous hatching was not observed even though the plugs were softened considerably by the enzyme.

In the first stage larvae a lancet shaped structure termed as oral spear or stylet was found by Deo (1960 b) and Thapar and Singh (1954) in T. ovis; by Alicata (1935) and Fulleborn (1923) in T. suis; and by Robert Rubin (1954) in T. vulpis. This structure was not seen in T. globulosa which may serve to distinguish it from other species.

Regarding the movements of larva inside the egg, the present observation agrees with that of Thapar and Singh (1954) who also observed no motility of the developed larvae inside the eggs.

According to Thapar and Singh (1954) the embryonated egg remained viable for 6 months. In the present studies it has been found to remain viable for 7 months at room temperature (27° to 31°C).

According to Ustinov (1973) all the larvae were seen

Fig. 28. Trichuris globulosa
Adult female -vulval region
(drawing)

Fig. 29. Trichuris globulosa
Adult female -posterior end
(drawing)

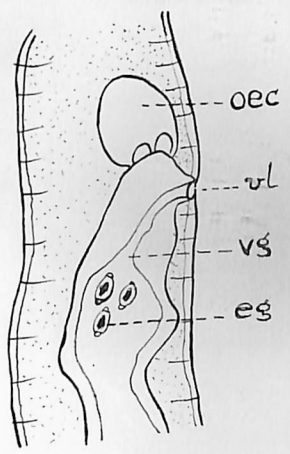


Fig. 28.

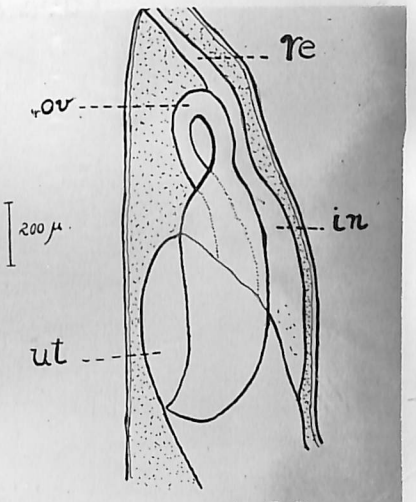


Fig. 29.

in the large intestine of kids sacrificed on 9th day of infection with T. ovis. In the present studies a few larvae were found still in the small intestine on the 10th day after infection.

Twenty sixth day old larvae of T. ovis according to Ustinov (1973) were hanging from caecal mucosa and their sexes were distinguishable. But in the present studies even the 35 days old larvae were free in the caecal lumen without attachment to mucous membrane and the sexes were not distinguishable, denoting a slower rate of development.

According to Ustinov (1973) T. ovis larvae on 38th day post infection were readily separable sexually and th they all remained penetrated into the caecal wall.

According to Deo (1960 b) 48-days-old T. ovis larvae remained in the abomasum and small intestine without yet migrating into the caecum and the larvae varied in their size depending upon the location. Those attached to the anterior part of small intestine being smaller than those attached to the posterior region. In the present studies also wider variations in the body sizes were noticed amon the developing juveniles.

According to Deo (1960 b) 61-days-old T. ovis larvae

were still immature and about half of the larvae were found in the posterior part of small intestine and the remaining in the caecum and colon. But in the present investigation all the larvae were found in the caecum and colon and none were seen in the small intestine. As reported by Deo (1960 b) the larvae were still immature on the 60th day.

No larval moulting could be observed in the case of T. globulosa in the present study. Other workers like Miller (1947) did not also observe any larval moulting in the case of T. vulpis. Tapar and Singh (1954) and Deo (1960 b) could not find any larval moulting in the case of T. ovis.

The prepatent period of T. ovis infection, according to Deo (1960 b) was 85-135 days, according to Dalchow (1964) 55 days, according to Artyukh (1963) 48-50 days, according to Tapar and Singh (1954) 48-84 days and according to Ustinov (1973) 51-50 days. The prepatent period of T. globulosa infection was 85-89 days as determined during the present studies, which is generally similar to that of T. ovis. The patent period of T. ovis was found to be 120-230 days by Ustinov, (1973). However in the present findings the patent period for T. globulosa infection was found to be more than one year.

The adults of Trichuris globulosa differ from those of T. ovis in having a comparatively shorter spicule, a globular swelling in the spicule-sheath instead of a bulbous swelling, longer spines on the globular swelling than those on the rest of the sheath. The latter character is just the reverse in T. ovis. The two species differ further in the measurement of eggs which is shorter in T. globulosa and longer in T. ovis (Patnaike, 1964).

EXPERIMENTAL TRICHURIS INFECTION IN GUINEA PIGS

The aim of these experiments was to determine the suitability of guinea pig for maintaining Trichuris globulosa in the laboratory, since the normal host viz., goats are costly.

Two laboratory reared guinea pigs free of any parasitic infection were administered with 1500 infective eggs of Trichuris globulosa. A healthy guinea pig was maintained with the infected ones as uninfected control. All the guinea pigs were maintained in cages within the laboratory, precluding extraneous infection. Their faeces were regularly examined for the presence of eggs of the parasite from 30 days post-infection. All the infected guinea pigs remained negative for infection even at the end of 4 months proving their unsuitability.

The experiment was repeated by infecting two more

guinea pigs with a higher dose (2000) of *T. globulosa* infective eggs.

In the 2nd experiment also the guinea pigs failed to become infected. From the above experiments it was concluded that guinea pigs could not be infected with *T. globulosa*.

PATHOLOGY AND TISSUE CHANGES IN *TRICHURIS GLOBULOSA* INFECTION IN KIDS

PATHOLOGY AND TISSUE CHANGES IN TRICHURIS GLOBULOSA INFECTION OF KIDS

Introduction

Artjuch (1936) and Barrows and Lillie (1964) found Trichuris to be blood feeders. Maen hout (1947) while working with Trichuris affinis reported that the worms caused swelling of the caecal mucosa and punctiform haemorrhages in the submucosa. According to Mozgovoi (1952) very heavy infection with Trichuris trichiura in young pigs, resulted in anaemia, blood in faeces, retarded growth, poor weight gain and even death. Similarly Powers et al. (1960) found Trichuris suis of pigs to cause anaemi anorexia, dysentery and pronounced weight loss. Powers (1961) reported that T. ovis and T. globulosa of sheep caused loss of weight, diarrhoea, blood in faeces, eosino-philia, sloughing of the caecal mucosa with cellular detritus. According to Bhatia and Pande (1961) T. ovis a T. globulosa of sheep caused superficial erosion of the caecal mucosa, necrosis of the glandular tissue around the worm embeded parts with infiltration of eosinophils. Soulsby (1965) was of the opinion that heavy infection of Trichuris in sheep and goats may cause thickening of caeca wall and excessive secretion of mucus. Quadir (1974) foun anaemia and oedematous swellings of the caecal wall and

petechial haemorrhages in calves infected with Trichuris. T. suis of pigs was found to cause epithelial degeneration of the parasitized area and activation of intestinal crypts and goblet cells (Ashizawa et al. 1975). Parleigh (1966) suggested that under conditions of stress T. ovis may assume a pathogenic role in sheep. Similarly Angus (1969) also suggested that in very heavy infection of sheep with Trichuris, diarrhoea with occassional blood in faeces and erosive changes in caecum and colon may occur. Bratanov (1968) found that T. ovis in lambs caused erythopenia, neutrophilia, leucocytosis and low haemoglobin. According to Bratanov and Krchev (1977) Trichuris infection in sheep caused varying degrees of pathological changes at the site of attachment of the worm in the caecal and intestinal mucosa depending upon the worm burden. They found also pathological changes in the liver, kidneys, spleen and lungs in severe infection. They further reported that sheep Trichuris is a blood sucker as they found host epithelial cells and erythrocytes in the intestine of the parasite. According to Datta et al.(1977) infection of pigs by T. suis resulted in profuse diarrhoea, anorexia, retardation of growth, dehydration and emaciation. Pande (1942) observed no pathological changes in goats infected with T. ovis, the number of helminths involved being 2 - 3000.

Present study

In the present study haematological and histopathological investigations were carried out in Trichuris globulosa infection in experimentally infected kids.

Haematological studies were made after the worms attained sexual maturity in infected kids. Six kids were used for the above studies. Four of them were infected and the remaining 2 served as uninfected controls. The blood samples were collected thrice at intervals of one week. These samples were subjected to various haematological studies such as erythrocyte sedimentation rate, packed cell volume, haemoglobin, mean corpuscular volume, mean corpuscular haemoglobin concentration, total count and differential count.

Analysis of the results (Table.2.) when compared with the values of uninfected kids shows a drop in MCHC. All other values show no significant variation. The drop in MCHC indicates that there was a mild anaemia in T. globulosa infection.

The histopathological studies were made by collecting materials after periodic slaughter of experimentally infected kids. This was done in 4 stages after infection, 1st on the 25th day post infection, 2nd on 50th day, 3rd

on 60th day and the last on 81st day.

On 25th day (Fig. 30) there were no gross lesions in the caecum. Cut sections of the organ showed small focal areas of degeneration and necrosis in the mucosa. The goblet cells were hyperative in isolated areas.

On 50th day (Fig. 31) sections showed very mild degenerative changes in the caecal mucosa with mild infiltration of inflammatory cells.

On 60th day (Fig. 32) the juveniles were firmly attached to the caecal mucosa. No lesions were noticed in any other organ. In the sections, focal areas of degeneration, necrosis and desquamation of the epithelial lining of the caecum was noticed. Moderate mucosal oedema and diffuse infiltration with macrophages, plasma cells and lymphocytes were also present. Necrotic debris was seen loosely adherent to the surface of the mucosa. In isolated areas goblet cells were hyperactive. Larval stages of the paras were seen embeded in the superficial mucosa. Foci of erosion at attachment sites were also noticed.

On 81st day (Fig. 33) the caecal mucosal surface was found to be studed with numerous worms. The caecal mucosa was slightly thickened. No gross lesions were noticed in any other organ.

Fig. 30. Section of caecal wall - 25 days after infection with Trichuris globulosa. Degeneration and necrosis of the caecal mucosa noticed.

Fig. 31. Section of caecal wall - 50 days after infection with Trichuris globulosa. Degeneration, necrosis and cut sections of worms seen.

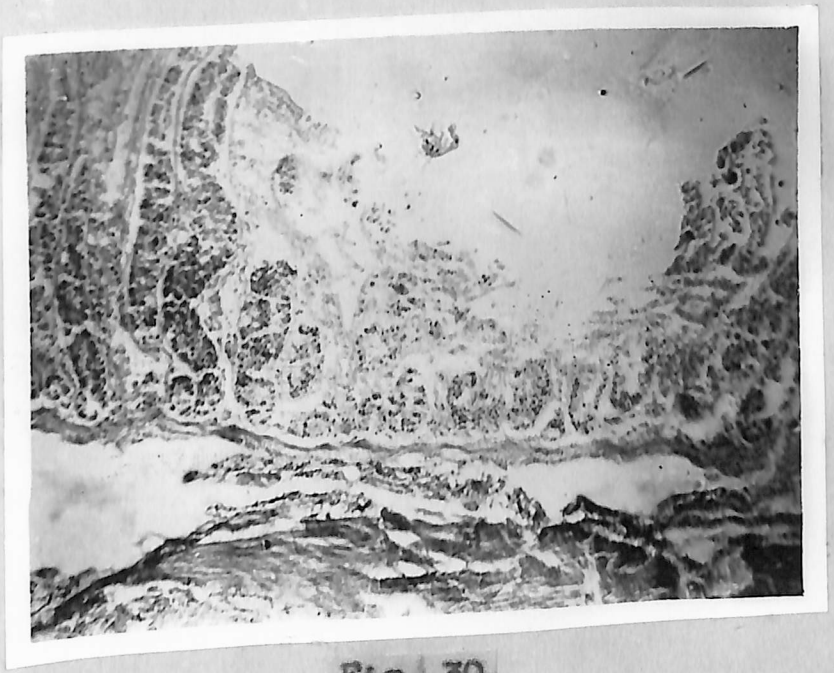


Fig. 30.

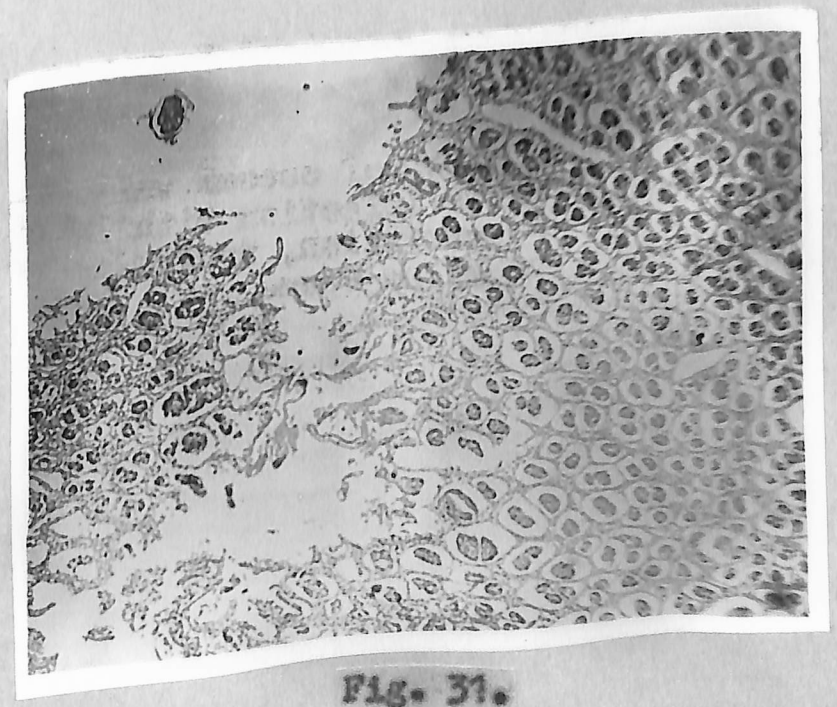


Fig. 31.

Sections showed severe necrosis of the superficial mucosa with focal ulceration. Many worms were seen embeded in the superficial mucosa. Lamina propria showed moderate diffuse oedema. There was diffuse infiltration of the mucosa with macrophages, lymphocytes, plasma cells and a few eosinophils. Goblet cells were hyper active.

No clinical signs were noticed at any stages of infection.

DISCUSSION

Literature on haematological and histopathological studies of Trichuris infection in sheep and goats are very scanty. The present study on goat trichuriasis was made at various stages of the life cycle of the parasite and perhaps the information furnished are new. Contrary to the findings of Pande (1942), in the present studies, Trichuris was found to be definitely, but mildly, pathogenic to the host. Sloughing of the caecal mucosa and cellular infiltration around the parasitised area observed in the present studies were in agreement with the findings of Powers (1961) and Bhatia and Pande (1961). Powers et al (1960) observed clinical symptoms in Trichuris infection of swine. But no such clinical signs were observed in the present studies. In agreement with the findings of

Fig. 32. Section of caecal wall- 60 days after infection with Trichuris globulosa. Degeneration, necrosis, desquamation of epithelium and cut section of juvenile parasites are seen.

Fig. 33. Section of caecal wall - 81 days after infection with Trichuris globulosa. Focal ulceration and cut section of worms are noticed.

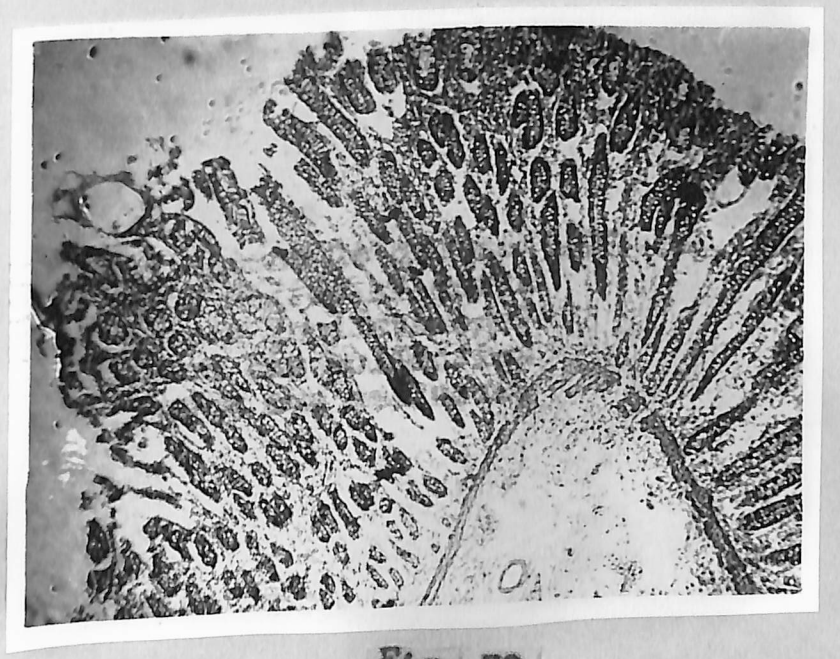


Fig. 32.

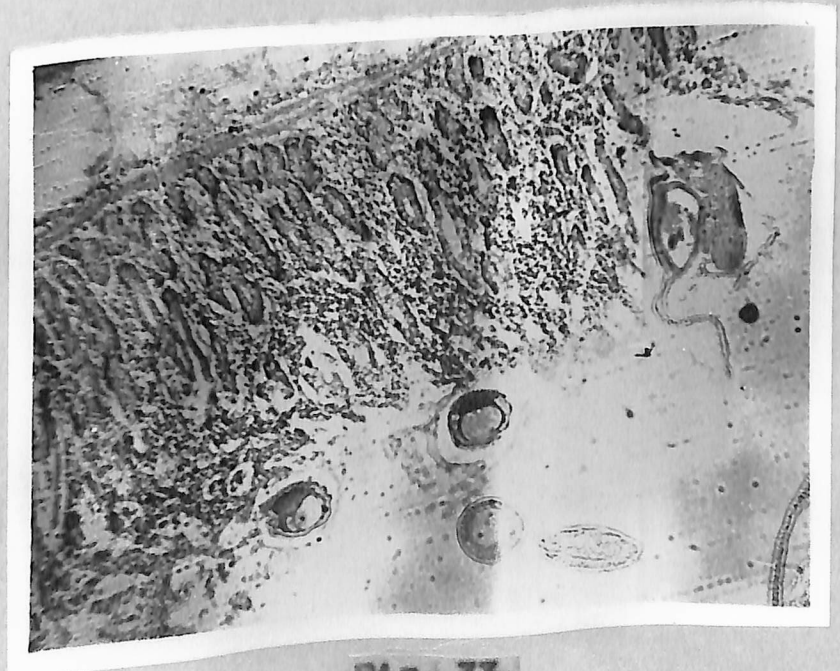


Fig. 33.

Soulsby (1965) and Qadir (1974), anaemia and thickening of the caecal mucosa was observed during the present studies. As reported by Ashizawa et al. (1975), goblet cells of the caecum were found to be activated in Trichuri globulosa infection. In agreement with Schanzel et al. (1966), there was no evidence of T. globulosa sucking the blood of the host. The reduction in mean corpuscular haemoglobin concentration, in the present studies could be due to other causes such as elaboration of toxic metabolic wastes of the parasite or due to other toxic principles associated with the parasite. Similar to the findings of Zratanov (1968) a low haemoglobin content was obse ved in the infected kids during the present studies also.

On the basis of current studies it can be concluded that heavy T. globulosa infection may adversely affect the health of kids.

Table 2.

Haematological findings on *Trichuris globulosa* infection in kids

	Infected				Control (Uninfected)	
Tattoo No. of kids	467	478	489	495	447	499
ESR (mm./hr)	<1	<1	<1	<1	<1	<1
PCV %	33	33	32	30	34	35
Haemoglobin g %	11.5	9.8	11.5	9.5	12.5	12.4
MCV	30	32.3	31.3	31.6	27.2	30.4
MCHC %	30.8	29.7	30.9	31.6	36.8	35.4
RBC million/ c.mm.	11	10.2	10.2	9.5	11.5	11.5
WBC thousand/c.mm.	3.5	3.7	4.2	4.1	3.8	3.5
Neutrophil %	45	49	46	49	40	38
Eosinophil %	4	4	3	2	Nil	Nil
Basophil %	Nil	Nil	Nil	Nil	Nil	Nil
Lymphocytes %	50	47	51	49	59	62
Monocytes %	1	Nil	Nil	Nil	1	Nil

PREPATENT PERIOD OF *STRONGYLOIDES PAPILLOSUS*

PREPATENT PERIOD OF STRONGYLOIDES PAPILLOSUS (WEDL. 1856)

Introduction

Zimm (1955) studied the prepatent period of Strongyloid papillosus using rabbits as the experimental host. The prepatent period according to him was 8-9 days. Garkavi (1956) reported that the prepatent period was 7-10 days in lambs. According to Abdel Gaward (1958) the prepatent period of the worm in lambs was 9 days. Soulsby (1968) reported that the prepatent period of S. papillosus was 5-7 days. Turner (195 appears to be the only worker who tried to set up experiment infection of S. papillosus in kids, through cutaneous route. However he did not report on the prepatent period of infection.

Present study

Six clean kids were infected orally with 7,000 infectiv larvae of Strongyloides papillosus. They were maintained in the laboratory under conditions precluding any chance of acquiring gastro-intestinal parasite. From the 3rd day onwards their faeces was collected daily and examined for th eggs of the parasite. Faecal cultures were also simultaneously set up for the development of larvae of S. papillosus, if any.

From the results (Table 3), it is observed that the

faeces of 3 kids became positive both microscopically and culturally for S. papillosus infection on the 6th day following infection and that of the rest became positive on 7th day of infection.

DISCUSSION

Considering the review of literature, the present study appears to be the 1st investigation on the prepatent period of Strongyloides papillosus in kids. In the present findings, it was found that the prepatent period of S. papillosus in kids ranged from 6-7 days under experimental conditions following oral route of infection. This observation was in close proximity with the report of Soulsby (1968) who found it to be 5-7 days. The prepatent period observed by other workers like Garkavi(1956), Timm (1955) and Abdel Gaward (1958) was slightly more (8-10 days) than that observed in the present findings, perhaps due to the differences in the host.

During the present studies, it was observed that kids readily picked up infection with S. papillosus through oral route as against the observations of Vegors and Porter (195 who found that calves were infectible with S. papillosus more readily through the skin than through the mouth.

It could also be noted from the present studies, that the kids could successfully be infected with a smaller number of larvae (as low as 7000) of Strongyloides papillosus whereas earlier workers reported that a massive dose of one lakh or more may be required to set up infection. (Abdel Gaward, 1968; and Turner, 1957).

Table 3.

Details of prepatent period of *Strongyloides papillosus* in kid

Tattoo number of goats	Date of infection	Number of larvae administered.	Date in which faeces became positive.	Prepatent period in days.
101	16-11-'77	7000	23-11-'77	7
102	"	"	22-11-'77	6
103	"	"	23-11-'77	7
104	"	"	22-11-'77	6
105	"	"	22-11-'77	6
489	"	"	23-11-'77	7

TRANSMISSION EXPERIMENTS WITH *NEOASCARIS VITULORUM* AND *OESOPHAGOSTOMUM COLUMBIANUM* IN HETEROLOGOUS HOSTS

TRANSMISSION OF NEOASCARIS VITULORUM IN HETEROLOGOUS HOSTS (GOAT AND GUINEA PIG)

Introduction

Shanmughalingam (1955) recorded the presence of Neoascaris vitulorum eggs in the faeces of 2 goats in Ceylon. Vasilev (1960) reported that Ascaris suum attained sexual maturity in kids. The same author in 1963 and 1965 failed to obtain sexual maturity of Ascaris lumbricoides in kids even after 65 days of infection. Mozgovoi and Shevtsov (1960) found 15 adult specimens of Ascaris from a kid in Kiev region which they named as Ascaris ovis. Vasilev (1963) questioned the validity of A. ovis. Earlier Vasilev (1959) obtained 18 Neoascaris vitulorum worms from the intestine of a kid on the 26th day after birth as a result of administration of the infective eggs to its mother during pregnancy. However another kid infected in a similar manner failed to become infected with the parasite. He further reported that administration of infective eggs of N. vitulorum directly to kid failed to develop to mature stage of the parasite, though immature stages in the lungs, liver and kidneys could be seen in the early stages of infection. Rajamohan et al. (1970) collected Ascaris eggs from a kid and were able to set up prenatal infection in a kid. The worms collected from that kid,

according to them were different from the known species of Ascaris as they were quite smaller in length. Gaur and Dao (1972) could set up experimental infection in heterologous hosts like kids, goats and monkeys with Ascaris lumbricoides. Experimental infection with A. suum in lambs could be set up by Hayat et al. (1973). Roneus and Christenesson (1977) could set up experimental infection in calves with A. suum.

Present study

Egg culture

The egg cultures of Neoascaris vitulorum were set up as described in materials and methods. The earliest time at which larvae (fig. 34) appeared in eggs was 10th day after setting up of the cultures.

Experimental infections

1) A total of 8 she goats at various stages of pregnancy ranging from 3 months to 4 3/4 months were each infected with 20,000 infective eggs of N. vitulorum. They were kept under observation in experimental sheds without any extraneous infection. The faeces of these goats were examined periodically at intervals of 5 days starting fro 1 month after infection. When they delivered, their kids were also examined regularly at 5 days interval starting from the 10th day after delivery. The post-mortem of kid

Fig. 34. Neoascaris vitulorum - hatched out larva (Photomicrograph)

Fig. 35. Neoascaris vitulorum - larva from guinea pig sacrificed 11th day after infection (Photomicrograph)

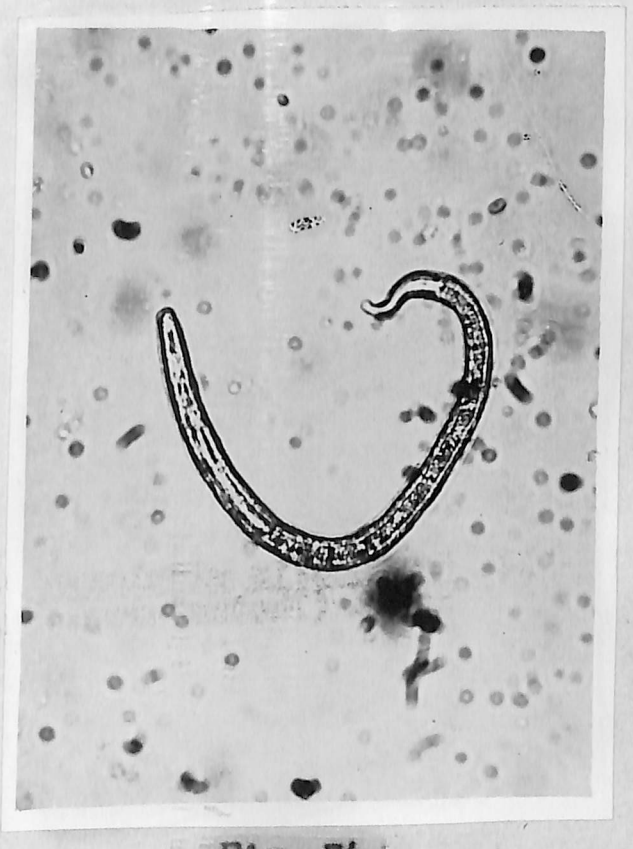


Fig. 34.

Fig. 35.

aborted if any, were also done within 2 hours after abortion.

2) Three kids were each infected directly with 2,000 infective eggs of N. vitulorum within 2 hours after their birth. The faeces of these kids were examin at regular intervals of 5 days starting from 1 month after infection. The examinations continued for about 2 months.

3) Five guinea pigs each, were infected with 2,000 infective eggs of N. vitulorum. They were sacrificed at different periods of infection commencing from 11 days t 3 months and 5 days to note the developing stages if any

The results of the 3 experiments are presented in tables 4, 5, and 6. The first experiment shows that neither the dams nor the kids picked up infection as evidenced by periodical faecal examination or detailed autopsy.

From the 2nd experiment it is observed that the kid did not pick up infection prenataly also.

In the 3rd experiment a few larvae (Fig. 35) could recovered from the liver and lungs of the guinea pigs sacrificed on 11th and 38th day after infection. The nu of larvae obtained on 11th day was 12 whereas that obtai on 38th day was 2. The larvae obtained on both the occa sionswere more or less of the same size. The measureme

are given in table 7.

DISCUSSION

The results of the experiment No.1 indicate that Neoascaris vitulorum does not develop in goat which is a heterologous host to the parasite. This observation is in agreement with that of Gaur and Deo (1972) who failed to set up experimental infection with Ascaris lumbricoides in heterologous hosts like kids, though other workers like Hayat et al. (1973), Roneus and Christänsson (1977) succeeded in setting up infection with Ascaris suum in calf which is a heterologous host to the parasite. Though Shanmughalingam (1956) observed the presence of Neoascaris vitulorum eggs in faeces of goats, he did not confirm it either by recovering the worm or by setting up experimental infection. His surmises as to the identify of the parasite was therefore not confirmed experimentally. Similarly Vasilev# (1959) who succeeded in setting up prenatal infection with N. vitulorum in one kid failed in his subsequent experiments. Though Rajamohan et al. (1970) could set up prenatal infection in a kid with Ascaris they felt that the parasite may be different from N. vitulorum since it was quite smaller in length. Moreover the source of the material for their infection experiment was a kid

and not a calf which is the natural host of Neoascaris vitulorum. The present observations indicate that goats are refractory to N. vitulorum infection. Cross transmission attempts to kid were repeated several times with the same results.

In the 2nd experiment it was found that post-natal feeding of kids with infective eggs of N. vitulorum also did not set up infection. This is in partial agreement with the observation made by Vasileva (1959) who also failed to obtain mature stages of the parasite in kids post-nataly infected though he got immature stages from the host.

The results of the 3rd experiment in guinea pigs indicate that N. vitulorum can develop in guinea pig post-nataly but it cannot develop to maturity in that host. This is in agreement with the findings of Vasileva (1959) who obtained only larval stages of N. vitulorum in the liver and lungs of kids and no mature stages on post-natal infection.

Table 4.

Details of cross transmission attempts with Neoascaris vitulorum to goats

Sl. No.	Tattoo No. of goats	Date of infection	Date of delivery/abortion	No. of kids borne	Result of examining the mother	Result of examining the kid	Result of F.M. examination
1.	152	20-12-'74	26-12-'74	1	Negative	Negative	..
2.	147	20-12-'74	26-12-'74	1	-do-	-do-	..
3.	032	8--1-'75	1--3-'75	2	-do-	-do-	..
4.	914	8--1-'75	5--2-'75 (aborted)	1	-do-	-do-	Negative
5.	102	15--2-'77	25--3--77	1	-do-	-do-	..
6.	101	25--2-'77	13--5-'77	1	-do-	-do-	..
7.	105	22--4-'77	29--5-'77	2	-do-	-do-	..
8.	103	12-12-'77	24-12-'77	1	-do-	-do-	..

Table 5.

Details of attempts at post-natal infection of kids with Neoascaris vitulorum

Sl.No.	Tattoo number	Date of infection	Result of examination
1.	205	5--8--'77	Negative
2.	202	6--8--'77	-do-
3.	207	17--4--'78	-do-

Table 6.

Details of infection of guinea pigs with Neoascaris vitulorum

Sl. No.	Date of infection.	Date of post-mortem	Result	No. of larvae obtained.	
				Liver	Lungs
1.	9--8--'77	26--10--'77	Negative	..	..
2.	9--8--'77	12--11--'77	Negative	..	..
3.	20--3--'78	31-- 3--'78	Positive	6	6
4.	20--3--'78	28-- 4--'78	Positive	1	1
5.	20--3--'78	25-- 6--'78	Negative	..	..

Table 7.

Measurements of Neoascaris vitulorum larvae from guinea pigs (in microns)

Particulars	11th day old		38th day old	
	from liver	from lungs	from liver	from lungs
Length	414	476	463	465
Buccal capsule size	7.5 x5	7.5 x5	7.5x7.5	7.5x7.5
Oesophagus length	122	160	183	184
Intestine length	268	280	244	250
Tail length	24	36	36	31

TRANSMISSION OF NEOASCARIS VITULORUM TO CALVES POST-NATALLY

Introduction

Mode of infection of Neoascaris vitulorum in calves is still a disputed subject. Some workers believe that infection is only prenatal, while others are of opinion that post-natal infection is also possible as in the case of other ascarids like Ascaris suum in pigs. But Refuerzo and Albis-Jimenez (1954) met with negative results when they attempted to infect 20 calves aged 1-13 days with 5,000 N. vitulorum eggs. However, Soulsby (1968) was of opinion that post-natal infection of calves with N. vitulorum was possible if infected within a few hours after birth. The present attempt was to explore the possibility of post-natal infection of calves with N. vitulorum.

Present study

Two calves each were infected orally with 50,000 infective eggs of N. vitulorum within 1½ to 2 hours after birth and before colustrum feeding. The calves were maintained in experimental sheds on milk initially and as they grew up concentrates and greens were also supplemented. The faeces of these calves was examined at weekly intervals for the presence of Ascaris eggs, commencing from the 1st month after infection up to a period of 3 months. After

TRANSMISSION OF *OESOPHAGOSTOMUM COLUMBIANUM* OF GOATS TO CATTLE

Introduction

An experiment was carried out to study the possibility of transmission of *Oesophagostomum columbianum* from goats to cattle. There appears to be no previous attempt in this aspect.

Experiment

Mature females of *Oesophagostomum columbianum* were collected from naturally infected goats. The eggs from these worms were harvested and they were cultured. The infective larvae obtained were administered to 2 calves and one kid which were raised free of worm infection previously. The calves were given 50,000 larvae each and the kid 10,000 larvae. The kid being the same species of host from which the adult worms were collected served to test the viability of the larvae. The animals were maintained in experimental sheds free of extraneous infection. Their faeces examined daily from 4th week after infection for the presence of eggs of the parasite. All the animals were killed at the end of 2 months and a thorough post-mortem recovery was conducted. The worms collected were counted.

The results are presented in the Table 9. From the

4 months they were sacrificed to recover developmental phases of the parasite, if any present.

The results (Table 8) showed that both faecal examination and post-mortem examination did not reveal the presence of Neoascaris vitulorum in calves.

Table 8.

Details of attempts at setting up post-natal infection of calves with Neoascaris vitulorum

Tattoo number	Date of infection	Time of infection after birth.	No. of eggs given	Result of faecal examination.	Date of sacrifice.	Result of post-mortem Exam:
101	10-12-'77	1½ hrs	50,000	Negative	10-4-'78	Negative
102	10-12-'77	3 hrs	50,000	Negative	10-4-'78	Negative

DISCUSSION

The present findings indicate that Neoascaris vitulorum infection in calves is probably not post-natal. This observation is in agreement with the findings of Refuerzo and Albio-Jimenez (1954) and is contrary to the opinion of Soulsby (1978) who believed that the post-natal infection in calves is possible if infected within few hours after birth.

results it is seen that calves did not pick up infection. But the goat became positive for infection on 40th day.

DISCUSSION

Since there are no previous reference, the present experiment appears to be the first on this line. From the experiment it is evident that calves could not be infected with Oesophagostomum columbianum of goats proving that O. columbianum is strictly host specific

Table 9.

Results of the experiment on transmission of Oesophagostomum columbianum to calves

Tattoo number of animals.	Date of infection.	No. of larvae given	Date of 1st appearance of eggs in faeces	Date of sacrifice.	Result of post-mortem examination.
101	11-2-'78	50,000	Negative	10-4-'78	Negative
102	11-2-'78	50,000	Negative	10-4-'78	Negative
107 (Goat)	11-2-'78	10,000	23-3-78	10-4-'78	200 worms

ASSESSMENT OF EFFICACY OF ANTHELMINTICS

ASSESSMENT OF EFFICACY OF ANTHELMINTICS

Introduction

A number of newer anthelmintics have been developed recently and many are available comercially. It is necessary to test the efficacy of these preparations in order to recommend them to practicing Veterinarians. Some of the criteria in the selection of suitable anthelmintic for field use are (a) the preparation should be effective in eliminating the parasite (b) should have wide therapeutic safety (c) should not adversely affect the health of the animals even if non toxic (d) should have a wider range of action (e) should have a good shelf life and (f) should be easy to administer. With the above criteria in mind a study was undertaken to assess first the efficacy of 4 newer anthelmintics viz., Oxibendazole, thiophanate, Albendazole and Parbendazole.

Review of literature

Oxibendazole-(methyl 5-n-propoxy-2-benzimidazole-carbamate) is an anthelmintic manufactured by Smith Kline Animal Health Products, Pennsylvania. Theodorides et al. (1973) found Oxibendazole at the rate of 5-20 mg/kg body weight to be 80-100% effective against the common gastro-intestinal nematodes of cattle like Haemonchus contortus, Ostertagia ostertagi, Trichostrongylus axei, Cooperia spp.

Trichostrongylus colubriformis and Oesophagostomum radiatum. Theodorides and Chang (1974) found Oxibendazole at the rate of 10 mg/kg body weight to eliminate from cattle 100% each of Ostertagia, Cooperia, Trichostrongylus and Oesophagostomum, 97% Strongyloides and 90% Haemonchus. According to Herlich (1975) Oxibendazole at the rate of 10 mg/kg body weight was 85-100% effective against H. contortus, O. ostertagi, T. axei, T. colubriformis and Cooperia oncophora and was ineffective against Oesophagostomum. Kates et al. (1975) reported Oxibendazole at the rate of 5-15 mg/kg body weight to be highly effective against common strongyles of equines. Violette and Pitois (1976) also found Oxibendazole to be highly effective against large strongyles of equines. Theodorides et al. (1976) found Oxibendazole at the rate of 10 mg/kg body weight to be highly effective against abomasal and intestinal worms including Bunostomes, Oesophagostomes and Trichuris of cattle. Crowley et al. (1976) found the drug to be highly effective against adults and larval nematodes of cattle. Nawalinski and Theodorides (1976) found Oxibendazole at the rate of 5 mg/kg body weight to be highly effective against mature and immature strongyles of ponies. Theodorides et al. (1976 b) found Oxibendazole, administered daily at the rate of 0.5, 1 or 2.5 mg/kg body weight, to be highly

effective against common strongyles of cattle. Accord-
ing to Vincent et al. (1976) the drug at the rate of
15 mg/kg body weight reduced faecal egg count of calves by
89% between 1 and 8 days after treatment. It exerted its
ovicidal property in 13-18 hours after treatment and
reduced the adult worm burden by 99-99.8%. Giardi et al.
(1977) found the drug at the rate of 15 mg/kg body weight
to remove 97% of abomasal worms and 100% of intestinal wor
except Trichuris ovis, from sheep. According to Williams
et al. (1978) the drug at the rate of 15 mg/kg body weight
was 99% effective against Haemonchus placei, Trichostrongyl
axei, T. colubriformis, Cooperia species, Bunostomum
phlebotomum and Oesophagostomum radiatum, more than 96%
against Ostertagia and more than 80% against Trichuris
species. Sathianesan et al. (1979 a) reported the drug
at the rate of 2.5 mg/kg body weight to be 96.9 - 100%
effective against the common strongyles of elephants.
Sathianesan et al. (1979 b) reported that the drug at the
rate of 40 mg/kg body weight to be 97-98% effective again
Ascaridia galli of poultry. The anthelmintic at the rate
10 mg/kg body weight was found to be 99-100% effective
against ancylostomes of dogs (Sathianesan et al. 1979 c).

Thiophanate ((diethyl 4, 4'-O-Phenylene bis(3-thio-
allophanate)) is a broad spectrum anthelmintic manufact-

ured by May and Baker Ltd. under the trade name 'Nemafax'. Eichler (1973) found thiophanate at the rate of 50 mg/kg body weight to remove 97-100% of Haemonchus contortus, Ostertagia species and Trichostrongylus species from sheep and cattle. The drug is reported to have a wide margin of safety. A single dose of thiophanate at the rate of 1000 mg/kg body weight was well tolerated by sheep and calves (Eichler, 1974). According to Rosa et al. (1975) the anthelmintic at the rate of 50 mg/kg body weight has an ovicidal property and it was evident from 6-48 hrs. after its administration. According to him its efficacy against Bunostomum trigonocephalum was 86% and against Oesophagostomum 84%. Baines and Colegrave (1977) reported that the drug at the rate of 75 mg/kg body weight kept the faecal egg count of sheep at a low level. Anandan and Lalitha (1977) reported that the drug at the rate of 50 mg body weight was 100% effective against strongyles of sheep and cattle as determined by faecal egg count. Dalton (1977 found that daily low level (50 or 200 mg/head) feeding of sheep with thiophanate reduced the egg out put, hatchability and worm burden. Dalton (1978) again obtained simila results in his experiments with sheep nematodes. Chandrasekharan et al. (1978) obtained 93-100% clearance of Haemonchus contortus, 100% of Oesophagostomum radiatum,

88-100% of Trichuris species and 73% of Strongyloides papillosus with the drug administered to calves at the rate of 50 mg/kg body weight. They further reported that the ovicidal property of the drug was evident from 24 hours after administration of the drug. Chandrasekharan et al. (1979) obtained complete elimination of strongyle eggs from the faeces of elephants treated with the drug @ 14 mg/kg body weight.

Albendazole (methyl (5-(propythio)-1 H-benzimidazole-2_{y1}) carbamate) is another newer anthelmintic developed by Smith Kline Animal Health Products, Pennsylvania. In his preliminary trial Theodorides et al. (1976 c) found Albendazole to be active against trematodes, cestodes and nematodes of domestic animals like sheep and cattle, at the rate of 10 mg/kg body weight. Theodorides et al. (1976 d) found Albendazole at the rate of 10 mg/kg body weight to be 100% effective against the immature stages of all common gastro-intestinal strongyles. Adult Trichuris species were only slightly affected at this dose level. Again Theodorides et al. (1976 e) found the drug at the rate of 5 mg/kg body weight to be at least 94% effective against Haemonchus contortus and Nematodirus spathiger of sheep. Williams et al. (1977) found the drug at the rate of 7.5 mg/kg body weight to be 99.4%

effective against Haemonchus and Cooperia in steers. According to Benz and Ernst (1977) removal of Haemonchus was not significant at the rate of 7.5 mg/kg body weight whereas Colglazier et al. (1977) reported that Albendazole at the rate of 2.5 mg and 5 mg/kg body weight was highly effective against adult stage of large and small strongylids. Ross et al. (1978) reported that the drug was 97.5 - 100% effective against Trichostrongylus colubriformis, Ostertagia circumcincta and Dictyocaulus filaria in lambs. At the rate of 5 mg/kg body weight Albendazole was found to be 100% effective against Trichostrongylus axei and Oesophagostomum species, 99% against Haemonchus species, Cooperia species and Trichostrongylus colubriformis, 98.3% against Ostertagia species, 96.2% against Bunostomum species and 20.2% against Trichuris species of cattle (Williams et al., 1977). According to Herlich (1977) the drug at the rate of 10 mg/kg body weight was only 74% effective against Haemonchus species, 99-100% against Ostertagia species, Trichostrongylus colubriformis, Cooperia oncophora and Oesophagostomum radiatum.

Parbendazole (methyl 5 (6) -butyl-2-benzimidazole carbamate) is also a product of S K F with the trade name 'Helatac'. This anthelmintic has been commercia-

lised a few years back and was chosen for comparing its efficacy with the other drugs. A high degree of efficacy for the anthelmintic against strongyles of sheep and cattle has been reported by Actor (1967). According to him the drug had only slight activity against Trichuris of sheep. At the rate of 15 mg/kg body weight Theodorides et al. (1968) found the drug to possess 100% activity against Haemonchus and trichostrongyles of goats but no action against Strongyloides papillosus. The same authors in 1969 reported a complete clearance of Strongyloides from goat at the rate of 20 mg/kg body weight. They obtained 95% clearance of Ostertagia and Nematodirus species with a dose rate of 30 mg/kg body weight and above. For a 70-90% clearance of Trichuris they had to use the anthelmintic at the rate of 20-60 mg/kg body weight. For a 99% clearance of Haemonchus species they had to use the drug at the rate of 60 mg/kg body weight. Against Trichostrongylus, Haemonchus, Ostertagia, Cooperia, Oesophagostomum and Strongyloides papillosus of sheep it was found by Ismaler et al.(1969) to be highly effective, but against Trichuris species they found it to be less effective. According to Johns and Mendel (1969) the drug at the rate of 15-22.4 mg/kg body weight was highly effective against Haemonchus.

Trichostrongylus, Ostertagia, Strongyloides and Nematodirus species. The drug was ovicidal at 6 hours after dosing and the treated sheep showed better weight gain than controls. Robert Robin (1969) reported a 92-100% efficacy for the drug at the rate of 30 mg/kg body weight against Haemonchus, Ostertagia, Trichostrongylus and Cooperia species of calves. According to Danek (1970/71) the drug at the rate of 15 mg/kg body weight given intraruminally to sheep showed 100% efficacy against Haemonchus, Ostertagia, Trichostrongylus, Cooperia, Bunostomum, Nematodirus, Oesophagostomum, Chabertia and it was less effective against Trichuris and Strongyloides species. Colglazier et al. (1971) found the drug to be highly effective against Ostertagia, Haemonchus and Trichostrongylus species of lambs at the rate of 20 mg/kg body weight. Hart and Bosman (1971) found the drug at the rate of 30 mg/kg body weight to be 94-100% effective against Haemonchus contortus, Ostertagia circumcincta, Trichostrongylus colubriformis, Gaigeria pachyscelis and Chabertia ovina. According to Gibson and Parfitt (1971) Parbendazole appeared to be only moderately effective against Nematodirus battus in sheep. Niec (1972) found the drug at the rate of 15 mg/kg body weight to be very effective against common nematodes of sheep except

Bunostomum species. Ovicidal action of the drug was noted within 5 hours of drenching. Queroz (1972) found a 100% reduction in nematode faecal egg count in sheep given Parbendazole at the rate of 20 mg/kg body weight. Gibson and Parfitt (1972) noticed a 100% elimination of Trichostrongylus axei from lambs at the rate of 15 mg/kg body weight of the drug. Lyons et al. (1974) found Parbendazole to be very effective against Haemonchus, Ostertagia, Trichostrongylus and Cooperia species, but poorly active against Trichuris ovis. According to Chandrasekharan et al. (1974) Parbendazole was 100% effective against Trichostrongylus colubriformis and Haemonchus contortus of calves and goats and Bunostomum trigonocephalum of goats. They found it to be only 51.6% effective against Trichuris globulosa of goats. Dey et al. (1976) obtained 100% efficacy for Parbendazole (30 mg/kg body weight) against abomasal and intestinal nematodes in goats on 5th day after administration. According to Varshney and Singh (1979) Parbendazole at the rate of 30 mg/kg body weight given to sheep gave 44.67% reduction of Haemonchus contortus, 95% reduction of Oesophagostomum columbianum and 97.5% reduction of Trichuris ovis.

Present study

In the present study a total of 4 treatment trials

were carried out to assess the comparative efficacy of the above mentioned anthelmintics.

Trial No. 1. (Treatment trial against Trichuris globulosa with recommended doses of the anthelmintics)

In this trial the comparative efficacy of Oxibendazole, thiophanate, Parbendazole and Albendazole at recommended doses against experimentally set up monospecific infection of Trichuris globulosa in goats, was assessed

A total of 15 goats having monospecific experimental infection of Trichuris globulosa formed the experimental animals for this trial. The goats were divided into 5 groups of 3 each. Out of the 5 groups 4 groups were medicated with the anthelmintics and the other group formed untreated control. The medicated groups were named after the anthelmintics administered to them viz., Oxibendazole group, thiophanate group, Albendazole group and Parbendazol group. Before medication individual faecal EPG of all the goats were taken for 3 days consecutively and the average was calculated (pretreatment EPG).

Immediately before medication body weight of each animal was also taken. The details of medication are given below.

All the kids were given the respective anthelmintics

orally, after suitably diluting the drug with water in a feeding bottle.

Oxibendazole group

The dose of Oxibendazole administered was at the rate of 10 mg/kg body weight.

Thiophanate group

Thiophanate at the rate of 50 mg/kg body weight was administered.

Albendazole group

Albendazole at the rate of 10 mg/kg body weight was given to the experimental kids.

Parbendazole group

Parbendazole was administered at the rate of 30 mg/kg body weight.

All the treated and the untreated groups were maintained in the experimental sheds under identical conditions. On the 5th day EPG of all the animals were taken.

RESULTS (Table 10.)

From the table the efficacy against Trichuris globulosa could be summarised as, Oxibendazole 48.6%, thiophanate 41%, Albendazole 47.3% and Prabendazole 49.3%.

Trial No. 2. (Treatment trial against Trichuris globulosa with double the recommended doses of the anthelmintics)

This trial was to determined the efficacy of Oxibendazole, thiophanate, Albendazole and Parbendazole at double the recommended doses against mono-specific infection of Trichuris globulosa.

The animals used for the trial No.1 formed the experimental animals for this trial also after giving sufficient interval for the complete elimination of the drugs during the previous dosage. The animals were given anthelmintics at double the recommended doses for this trial.

The pretreatment and post-treatment EPGs of the animals were collected as in the 1st trial.

RESULTS (Table 11.)

It can be seen from the table that when the animals were remedicated with double the recommended dose the percentages of efficacy were as follows:

Oxibendazole	100%
thiophanate	89%
Albendazole	96%
Parbendazole	100%

Trial No.3. (Treatment trials against common strongyles and Strongyloides)

Comparative efficacy of the 4 anthelmintics against the common strongylea and Strongyloides in goats was also determined together with their ovicidal property and influence on the weight gain of treated goats.

Twenty five goats artificially infected with Haemonchus contortus, Trichostrongylus colubriformis, Bunostomum trigonocephalum, Oesophagostomum columbianum, O. asperum and Strongyloides papillosus were used for this trial. These animals were divided at random into 5 groups of 5 animals each. Their faecal EPG was taken for 5 days prior to medication and their faeces were cultured and differential larval counts and larvae per gram of faeces were also determined. On the day of medication they were weighed and medicated as follows:

Oxibendazole group

The animals of this group were given Oxibendazole at the rate of 10 mg/kg body weight.

Thiophanate group

Animals of this group were given thiophanate at the rate of 50 mg/kg body weight.

Albendazole group

The drug was administered at the rate of 10 mg/kg body weight.

Parbendazole group

Parbendazole at the rate of 30 mg/kg body weight was administered.

Control group

This group was maintained as infected and untreated group.

After medication all the animals were maintained in the experimental sheds under identical conditions and their faeces examined and cultured at every one hour after medication till all eggs disappeared from the faeces of treated goats. On the 5th day post medication EPG and larval counts were also determined and one animal from each group was sacrificed. On post-mortem, worms both mature and immature present in each animal were recovered completely.

On 30th day body weights of all the animals were recorded.

RESULTS (Table 12-16)

Oxibendazole group

Based on EPG Oxibendazole had shown an efficacy of

100% against both strongyles and Strongyloides papillosus.

Based on larval counts oxibendazole had shown 100% efficacy against Haemonchus contortus, Trichostrongylus colubriformis, Bunostomum trigonocephalum, Oesophagostomum columbianum, O. asperum and Strongyloides papillosus.

On the basis of clearance of worms the anthelmintic was 100% effective against Haemonchus contortus Trichostrongylus columbriformis, Bunostomum trigonocephalum, Oesophagostomum columbianum, O. asperum, Strongyloides papillosus and immature gastro-intestinal nematodes.

The drug was ovicidal in its action from the 6th hour after its administration.

Body weight gain was 2 kg per animal/month which worked out to be 14.8% of the pretreatment body weight.

Thiophanate group

Based on EPG thiophanate had shown an efficacy of 97.7% against strongyles and 100% against Strongyloides papillosus

On larval count basis thiophanate was 96.6% effective against Haemonchus contortus, and 100% against

Trichostrongylus colubriformis, Bunostomum trigonocephalum, Oesophagostomum columbianum, O. asperum and Strongyloides papillosus.

Based on clearance of worms the drug had shown an efficacy of 97% against H. contortus and 100% against T. colubriformis, B. trigonocephalum, O. columbianum, O. asperum and S. papillosus and 74% against immature gastro-intestinal nematodes.

The ovicidel property of the drug was evident from 9th hour after its administration.

Its influence on the body weight gain was measured to be 1.5 kg per head per month which was 10% of the pretreatment weight.

Albendazole group

Based on EPG, Albendazole was 100% effective against strongyles and Strongyloides papillosus.

Based on larval counts Albendazole had shown 100% efficacy against each of H. contortus, T. colubriformis B. trigonocephalum, O. columbianum, O. asperum and S. papillosus.

On the basis of clearance of worms it was 100% effective against both mature and immature forms.

Body weight gain of treated group was 2 kg per head per month which was 16% of the pretreatment body weight.

Parbendazole group

Based on EPG, Parbendazole had shown an efficacy of 100% against strongyles and 90.9% against Strongyloides papillosus

On larval count basis Parbendazole had shown 100% efficacy against Haemonchus contortus, Trichostrongylus colubriformis, Oesophagostomum columbianum, O. asperum and Strongyloides papillosus and 96.9% against Bunostomum trigonocephalum.

Based on clearance of worms Parbendazole was 100% effective against H. contortus, T. colubriformis, O. columbianum, O. asperum and S. papillosus, 96.6% against B. trigonocephalum and 85% against immature gastro-intestinal nematodes.

Ovicidal property of the drug was evident only from 11th hour after medication.

Body weight gain of the treated group was 1.3 kg per animal per month which was 10.7% of the pretreatment body weight.

Control group

In this group EPG and larval count did not show any reduction. Rather they showed an increase during the period of observation. Body weight gain of this group was 1 kg per animal per month which was only 6.9% of the pretreatment weight of the group.

Trial No. 4. (*In vitro* action of the anthelmintics against *Haemonchus contortus*)

A trial to assess the efficacy of the anthelmintics by *in vitro* technique was conducted. As detailed under materials and methods 10 live freshly collected *Haemonchus contortus* adult worms were kept in 5 cc of 1 : 10,000 aqueous preparations of Oxibendazole, thiophanate (Nemafax) Albendazole and Parbendazole. In a similar control petridish only 5 cc of water was used. They were examined under a dissection miscroscope at 1 hour interval.

RESULTS (Table 17.)

The *in vitro* lethal action of the four anthelmintics on *Haemonchus contortus*, as per descending order of efficacy was as follows:

Oxibendazole - 2 hours, Albendazole - 9 hours, Thiophanate (Nemafax) and Parbendazole - 10 hours each. Compared to the above, the worms survived in plain water fo 11 hours.

DISCUSSION

Oxibendazole

According to the present findings the efficacy of Oxibendazole at the recommended dose of 10 mg/kg body weight against Trichuris globulosa was only 48.6%. This is in contrast to the findings of Theodorides et al. (1976 a) who got a high percentage of clearance of the worm at the same dosage. The present findings agree with those of Giardi et al. (1977) who did not get a satisfactory clearance of Trichuris even at a higher dose of 15 mg/kg body weight. In the present trials a 100% clearance of Trichuris was obtained when the dosage increased to 20 mg/kg body weight. Williams et al.(1978) also reported better clearance of worms at higher dose levels.

Efficacy of Oxibendazole at the rate of 10 mg/kg body weight against Haemonchus contortus was 100% in the present study. This is more or less in agreement with the results obtained by Herlich (1975) who got 85-100% efficacy with 5 or 10 mg/kg body weight of oxibendazole. But to get 100% efficacy against Haemonchus Williams et al. (1978) and Giardi et al. (1977) had to use 15 mg/kg body weight of the drug. Theodorides and Chang (1974) got only 90% clearance of Haemonchus with

10 mg/kg body weight of the anthelmintic whereas 100% clearance of the worm was obtained during the present trials.

Against Trichostrongylus colubriformis the efficacy obtained in the present findings is in agreement with those of Theodorides and Chang (1974), Herlich (1975) and Theodorides et al. (1976 a) who also obtained 100% efficacy with 10 mg/kg body weight of the drug. But Williams et al. (1978) had to use a dose rate of 15 mg/k body weight to get a nearly 100% efficacy.

Against Bunostomum trigonocephalum the efficacy obtained in the present findings is in agreement with that of Theodorides et al. (1973) and Theodorides et al. (1976 a) who also obtained more or less complete elimination of the parasite at the above dose. But Williams et al. (1978) and Giardi et al. (1977) had to use 15 mg/ body weight of the drug to get almost 100% efficacy against the worm.

Against Oesophagostomum species the result obtained in the present study is in agreement with that of Theodorides et al. (1973), Theodorides and Chang (1974), Herlich (1975) and Theodorides et al. (1976 a) who also obtained 100% efficacy against Oesophagostomum species with 10 mg/kg body weight of the drug. But to get almos

equal percentage of efficacy Giardi et al. (1977) and Williams et al. (1978) had to use a higher dosage of 15 mg/kg body weight.

Against Strongyloides papillosus the present result is in agreement with the results obtained by Theodorides et al. (1973). Theodorides and Cheng (1974) and Theodorides et al. (1976 a) who also obtained similar results with the same dose of the drug. However, Giardi et al. (1977) had to use a higher dose of 15 mg/kg body weight of the drug to get 100% elimination of the worm.

Against immature stages, the efficacy of the anthelmintic at the rate of 10 mg/kg body weight was 100%. This is in agreement with Theodorides et al. (1976 a) who obtained complete elimination of immature form with the same dose rate of the drug.

Reduction of EPG in the present findings was 100%, but according to Vincent et al. (1976) faecal egg count was reduced by, only 89%, even at the high dosage rate of 15 mg/kg body weight.

The ovicidal property of the drug was reported from 13th - 17th hours after medication by Vincent et al. (197 During the present study ovicidal action of the drug was evident even from 6th hour of medication.

Thiophanate

Trichuris globulosa eggs in faeces were reduced by 41% when thiophanate was given at the rate of 50 mg/kg body weight in the present study. This is more or less in agreement with the findings of Chandrasekharan et al. (1978) who also obtained only a smaller percentage of (57-82%) clearance of eggs in faeces. Baines et al.(197 obtained 96-99% clearance of faecal egg count with the same dose rate of thiophanate which was much higher than those observed during the current trials.

Against Haemonchus contortus the efficacy of thiophanate was 97% in the present study. This was in close agreement with the results obtained by other workers lik Eichler (1973), Rosa et al. (1975), Anandan and Lalitha (1977) and Chandrasekharan et al. (1978).

Against Trichostrongylus colubriformis the result obtained in the present study agrees with that obtained by previous workers like Eichler (1973), Rosa et al.(197 Anandan and Lalitha (1977) and Chandrasekharan et al. (1978).

Against Bunostomum trigonocephalum thiophanate at the rate of 50 mg/kg body weight was 100% effective in the present study, while Rosa et al.(1975) obtained only 86% efficacy against the worm.

Against Oesophagostomum species the drug was 100% effective which was in agreement with those of Chandrasekharan et al. (1978). However Rosa et al. (1975) could observe only 84% efficacy against this species of worms.

Against Strongyloides papillosus the 100% efficacy obtained in the present experiments was in agreement with that obtained by Rosa et al. (1975). Chandrasekharan et al. (1978) obtained only 73% efficacy.

Against faecal egg out put, the efficacy of thiophanate at the rate of 50 mg/kg body weight was 97.7% in the present study. But Dalton (1977) got a reduction in egg count in lambs grazing on contaminated pasture, only after a daily administration of thiophanate at the rate of 50 mg/kg body weight for 14 weeks.

There appears to be no reference on the efficacy of the drug against immature forms.

The ovicidal property of the drug was evident from the 9th hour after its administration, and according to Rosa et.al. (1975) it was evident from 6th - 48th hour. Hence the finding came within the range given by the above workers.

Albendazole

Albendazole at the rate of 10 mg/kg body weight was

only 47.3% effective against Trichuris globulosa. At the rate of 20 mg/kg body weight the efficacy was found to be 96%. Hence, the drug at the recommended dose of 10 mg/kg body weight had low efficacy against Trichuris. This finding is supported by the result obtained by Williams et al. (1977) and Theodorides et al. (1976 d) who also found that the drug was poor in its efficacy against Trichuris species.

Against Haemonchus contortus Albendazole at the rate of 10 mg/kg body weight was 100% effective which was in agreement with the results obtained by Theodorides et al. (1976 d) who noted 99% clearance with a dosage rate of 5 mg/kg body weight. At 2.5 mg/kg body weight the same authors (1976 c) obtained only 79% elimination. Herlich, (1977) had reported only 74% efficacy for the drug at the rate of 10 mg/kg body weight against Haemonchus contortus.

Against Trichostrongylus colubriformis Albendazole was 100% effective, which was in close conformity with that of Herlich (1977) and Ross et al. (1978) who also got nearly 100% efficacy against this worm with the drug at the rate of 10 mg/kg body weight. At a reduced dosage of 2-5 mg/kg body weight Theodorides et al. (1976 d

could observe 99% efficacy. Williams et al. (1977) have also noted 100% efficacy with a dosage as low as 5 mg/kg body weight of the drug.

In the present findings the efficacy against Bunostomum trigonocephalum was 100% which was in agreement with that obtained by Theodorides et al. (1976 d) and Williams et al. (1977) who also noted a high percentage of efficacy even at lesser dosage of 2-5 mg/kg body weight respectively.

Against Oesophagostomum species the efficacy obtained in the present study was 100% which was in agreement with that of Herlich (1977) and Williams et al. (1977) who also got 100% efficacy. The latter authors however, used only 5 mg/kg body weight of the drug.

Against Strongyloides papillosus the efficacy obtained in the present findings was 100% which was in agreement with the result reported by Theodorides et al. (1976 d) who noticed 88% of efficacy even at a lov dosage rate of 2.5 mg/kg body weight of the drug.

Reduction of faecal EPG with 10 mg/kg body weight of the drug was 100% in the present findings. Similarly a cent percent reduction of faecal EPG was noticed by Ross et al. (1978).

Against immature forms the efficacy noticed in the present study was 100% at the recommended dose of the anthelmintics. This was more or less in agreement with that obtained by Williams et al. (1977) who got 86.4 - 91.9% efficacy. Theodorides et al. (1976 d) observed only 83% efficacy against immature forms.

There appears to have no references for comparing the ovicidal property of the drug.

Parbendazole

At the recommended dose of 30 mg/kg body weight Parbendazole was found to be only 49.3% effective against Trichuris globulosa in the present study. This result was in agreement with the findings of other workers like Danek et al. (1970/71), Lammler et al.(1969 Actor (1967), Hart and Rosman (1971), Lyons et al.(1974 and Chandrasekharan et al. (1974) who also found the drug to be less effective against this species of worms. Varshney and Singh (1979) and Theodorides et al. (1969) however have reported a better efficacy of 90% and above with more or less equivalent dosage of the anthelmintic.

Against Haemonchus contortus Parbendazole at the rate of 30 mg/kg body weight was 100% effective in the

present findings. The results obtained by other workers like Theodorides et al. (1968), Lammler et al. (1969), Robert Rubin (1969), Danek et al. (1970/71), Hart and Bosman (1971), Lyons et al. (1974), Chandrasekharan et al. (1971) and Varshney and Singh (1979) were also similarly high.

Against Trichostrongylus columbriformis the efficacy of parbendazole noticed in the present study was 100%. Similarly, high percentage of efficacy was noticed by other workers like Theodorides et al. (1968), Theodorides et al. (1969), Lammler et al. (1969), Robert Rubin (1969) Danek et al. (1970/71), Hart and Bosman (1971), Lyons et al. (1974), Chandrasekharan et al. (1974) and Dey et al (1976).

Against Bunostomum trigonocephalum the drug was 86.6% effective, which was in agreement with the findings of Nieo (1972) who also obtained only a partial efficacy against this species of worm. However, Danek et al. (1970/71) and Chandrasekharan et al. (1974) reported 100% efficacy against the worm.

In the present study efficacy of the drug against Oesophagostomum species was noticed to be 100%. A very high percentage of efficacy was also noticed by other

workers like Robert Rubin (1969) Lammler et al. (1969), Theodorides et al. (1969), Danek et al. (1970/71) and Varshney and Singh (1979).

In the present study efficacy of Parbendazole against Strongyloides papillosus was 100%. Similarly high percentage of efficacy was also noticed by Johns and Mendel (1969), Theodorides et al. (1969) Lammler et al. (1969) and Chandrasekharan et al. (1974). At half the recommended dose the drug was reported to be ineffective by Theodorides et al. (1968), Danek et al. (1970/71) and Lyons et al. (1974).

In the present study the drug was found to be only 85% effective against immature forms. However other workers like Johns and Mendel (1969), Hart and Bosman (1971), Lyons et al. (1974) and Dey et al. (1976) reported much higher percentage of efficacy against immature forms.

Reduction in the faecal egg count was noticed to be 90.9% in the present study which was in agreement with the result obtained by Varshney and Singh (1979) who also noticed a substantial reduction in EPG. Nevertheless, Quoros et al. (1972) and Dey et al. (1976) have reported absolute reduction in EPG, 5 days after its

administration.

In the present study the ovicidal action of the drug was noticed from 11th hour after its administration, whereas Johns and Mendel (1969) and Miec et al. (1972) noticed the ovicidal property as early as 6th hour and 5th hour respectively.

Out of the 4 anthelmintics tried Oxibendazole and Parbendazole gave 100% efficacy against Trichuris globulosa. Albendazole came next in order with 96% efficacy and thiophanate had a least efficacy of 89% when all the drugs were tried at double the recommended doses.

Regarding the efficacy of the anthelmintics against other nematodes, all the drugs gave 100% efficacy against the common nematodes except thiophanate against Haemonchus contortus where it was only 97% effective and Parbendazole against Bunostomum trigonocephalum where it was only 86.6% effective.

Against immature forms, while Oxibendazole and Albendazole were 100% effective Parbendazole and thiophanate gave only 85% and 74% efficacies respectively.

Regarding the efficacies of the anthelmintics in in vitro studies, Oxibendazole took a minimum time of

2 hours to kill Haemonchus contortus while thiophanate and Parbendazole took the maximum time of 10 hours each. Albendazole took a middle position in exerting lethal effect (9 hours).

Regarding the influence on the weight gain of treated goats Albendazole gave a maximum weight gain of 16% closely followed by Oxibendazole with 14.6%. The third in the order was Parbendazole with 10.7% and thiophanate had only the minimum influence (10%).

In the present studies all the 4 anthelmintics were found to be well tolerated even at double the recommended doses.

Out of the 4 anthelmintics used Oxibendazole and Albendazole are the drugs of choice with matching efficacies against all the common gastro-intestinal nematodes of goats.

Except Parbendazole all the other 3 drugs were tried in goats for the 1st time. All the drugs tested had good shelf-life and were easy to administer.

Table 10.

Comparative efficacy of the four anthelmintics at the recommended doses against Trichuris globulosa

Group name	Oxibendazole group			Thiophanate group			Albendazole group			Parbendazole group			Control group		
Tattoo nos.	232	467	233	304	478	302	101	102	103	305	495	489	104	105	106
Pre treatment EPG	1000	1200	1300	1100	1100	900	1300	1500	1200	1400	900	1200	1100	1300	1500
Post-treatment EPG	500	700	600	700	500	600	800	700	600	700	400	700	1200	1300	1800
Reduction in EPG	500	500	700	400	600	300	500	800	400	700	500	500	-100*	100	-300*
Efficacy/head in percentage	50	42	54	36	55	33	39	53	50	50	56	42	-9	8	-20
Efficacy/group in percentage	..	48.6	..	..	41	..	..	47.3	..	..	49.3	..	..	7	..

* - indicates increase in EPG count.

Table 11.

Comparative efficacy of the four anthelmintics at double the recommended doses against Trichuri globulosa

Group name	Oxibendazole group			Thiophanate group			Albendazole group			Parbendazole group			Control group		
Tattoo nos.	232	467	233	304	478	302	101	102	103	305	495	489	104	105	106
Pre treatment EPG	500	700	700	700	500	600	800	700	600	700	400	700	1200	1200	1800
Post-treatment EPG	Nil	Nil	Nil	100	100	Nil	100	Nil	Nil	Nil	Nil	Nil	1100	1200	1900
Reduction in EPG	500	700	700	600	400	600	700	700	600	700	400	700	100	Nil	-100*
Efficacy/head in percentage	100	100	100	86	80	100	88	100	100	100	100	100	8	Nil	-6*
Efficacy/group in percentage	..	100	..	..	89	..	..	96	..	..	100	..	..	-5	..

* - indicates increase in EPG count.

Table 12.

Efficacy of the four anthelmintics against strongyles and Strongyloides based on EPG

Name of the group	Oxibendazole group		Thiophenate group		Albendazole group		Parbendazole group		Control group	
Mean EPG	strongyles	S.papillosus	strongyles	S.papillosus	strongyles	S.papillosus	strongyles	S.papillosus	strongyles	S.papillosus
Pre treatment	12000	1000	13000	900	11000	800	10000	1100	12000	1000
Post-treatment	Nil	Nil	300	Nil	Nil	Nil	Nil	100	13000	1100
Reduction	12000	1000	12700	900	11000	800	10000	1000	-1000*	-100*
Percentage of efficacy	100	100	97.7	100	100	100	100	90.9	-8.3*	-10*

* - indicate increase in EPG count.

Tab

Efficacy of the four anthelmintics against stron

Group	Oxibendazole group							Thiophanate group					
Percentage of mean larval count	H.c.	T.c.	B.t.	O.c.	O.a.	S.p.	No./g.of faeces	H.c.	T.c.	B.t.	O.c.	O.a.	S.
Pre treatment	37	8	5	25	15	10	1500	33	10	6	22	18	1
Post-treatment	Nil	Nil	Nil	Nil	Nil	Nil	Nil	20*	Nil	Nil	Nil	Nil	Ni
Percentage of efficacy	100	100	100	100	100	100	100	96.6	100	100	100	100	10

H.c. Haemonchus contortus
T.c. Trichostrongylus colubriformis
B.t. Bunostomum trigonocephalum
O.c. Oesophagostomum columbianum
O.a. Oesophagostomum asperum
S.p. Strongyloides papillosus

* indicates actual number
- indicates increase

Tabl

Efficacy of the four anthelmintics against strong

Name of the group	Oxibendazole group							Thiophanate group					
Percentage of mean larval count	H.c.	T.c.	B.t.	O.c.	O.a.	S.p.	No./g.of faeces	H.c.	T.c.	B.t.	O.c.	O.a.	S.p
Pre treatment	37	8	5	25	15	10	1500	33	10	6	22	18	11
Post-treatment	Nil	Nil	Nil	Nil	Nil	Nil	Nil	20*	Nil	Nil	Nil	Nil	Nil
Percentage of efficacy	100	100	100	100	100	100	100	96.6	100	100	100	100	100

H.c. Haemonchus contortus
T.c. Trichostrongylus colubriformis
B.t. Bunostomum trigonocephalum
O.c. Oesophagostomum columbianum
O.a. Oesophagostomum asperum
S.p. Strongyloides papillosus

* indicates actual number
- indicates increase

oneylloides based on pre and post-treatment larval counts

	Albendazole group						Parbendasole group						Control group					
.c.	T.c.	B.t.	O.c.	O.a.	S.p.	No./g.of faeces	H.c.	T.c.	B.t.	O.c.	O.a.	S.p.	No./g.of faeces	H.c.	T.c.	B.t.	O.c.	O.a.	S.p.
42	9	6	15	18	10	1400	36	10	8	22	17	7	1600	35	8	5	22	18	12
Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	4*	Nil	Nil	Nil	Nil	38	7	4	22	19	10
100	100	100	100	100	100	100	100	100	96.9	100	100	100	100	-8.6	12.5	20	..	-5.5	16.6

gyloides based on pre and post-treatment larval counts

Albendazole group								Parbendazole group								Control group					
.c.	B.t.	O.c.	O.a.	S.p.	No./ g.of fae- ces	H.c.	T.c.	B.t.	O.c.	O.a.	S.p.	No./ g.of fae- ces	H.c.	T.c.	B.t.	O.c.	O.a.	S.p.
9	6	15	18	10	1400	36	10	8	22	17	7	1600	35	8	5	22	18	12
11	Nil	Nil	Nil	Nil	Nil	Nil	Nil	4*	Nil	Nil	Nil	Nil	38	7	4	22	19	10
00	100	100	100	100	100	100	100	96.9	100	100	100	100	-8.6	12.5	20	..	-5.5	16.6

Table 14

Comparative efficacy of the four anthelmintics against the common gastro-intestinal nematodes of goats based on the number of worms recovered on slaughter after treatment

Group name	Haemonchus contortus	Trichostrongylus colubriformis	Bunostomum trigonocephalum	Oesophagostomum columbianum	Oesophagostomum asperum	Strongyloides papillosus	Immature forms
Control group	175	610	15	88	70	50	68
Oxibendazole group	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Thiophanate group	5	Nil	Nil	Nil	Nil	Nil	18
Albendazole group	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Parbendazole group	Nil	Nil	2	Nil	Nil	Nil	10
			Reduction percentage				
Oxibendazole group	100	100	100	100	100	100	100
Thiophanate group	97	100	100	100	100	100	74
Albendazole group	100	100	100	100	100	100	100
Parbendazole group	100	100	86.6	100	100	100	85

Table 15.

Comperative efficacy of the four anthelmintics based on body weight gain (in kg) after medication

Group name	Oxibendazole group	Thiophanate group	Albendazole group	Parbendazole group	Control group
Pre treatment weight	13.5	15.0	12.5	14.0	14.5
Post-treatment weight	15.5	16.5	14.5	15.5	15.5
Weight gain	2.0	1.5	2.0	1.5	1.0
Percentage of weight gain	14.8	10.0	16.0	10.7	6.9

Table 16.

Results of examination of faecal samples of goats at every 1 hour after medication

Time of collection of faeces.	Oxibendazole group	Thiophanate group	Albendazole group	Parbendazole group	Control group
From '0' hr. to 5th hour	Positive	Positive	Positive	Positive	Positive
6th hour	Negative	Positive	Positive	Positive	Positive
7th hour	Negative	Positive	Positive	Positive	Positive
8th hour	Negative	Positive	Negative	Positive	Positive
9th hour	Negative	Negative	Negative	Positive	Positive
10th hour	Negative	Negative	Negative	Positive	Positive
11th hour	Negative	Negative	Negative	Negative	Positive

Table 17.

In vitro studies on the efficacy of the four anthelmintics at 1 : 10000 aqueous suspension against *Haemonchus contortus*

Name of anthelmintic/agent	Observation made at 1 hour interval										
	1st hr.	2nd hr.	3rd hr.	4th hr.	5th hr.	6th hr.	7th hr.	8th hr.	9th hr.	10th hr.	11th hr.
Oxibendazole	alive	dead	..	..	..	..	..	..	..	..	..
Nemafax (Thiophanate)	alive	alive	alive	alive	alive	alive	alive	alive	alive	dead	..
Albendazole	alive	alive	alive	alive	alive	alive	alive	alive	dead	..	..
Parbendazole	alive	alive	alive	alive	alive	alive	alive	alive	alive	dead	..
Water	alive	alive	alive	alive	alive	alive	alive	alive	alive	alive	dead

SUMMARY

Life history of Trichuris globulosa has been studied for the first time. Of the various media tried aerated distilled water gave good results for embryonation of eggs of T. globulosa. The first stage larva was fully developed on the 15th day of setting up the culture. Unlike T. ovis larva, there was no oral spear in the larva of T.globulosa. By administering 10,000 infective eggs of T. globulosa, experimental infection could successfully be set up in kids. Different parasitic stages of the worm were studied in detail by recovering them after periodical slaughter of experimental kids. The prepatent period of T.globulosa was found to be 85-89 days and the patent period to be more than one year. Attempt to establish infection in guinea pigs, met with failure.

Haematological and pathological changes in experimentally infected kids with T. globulosa, were studied. The worm was found to be definitely pathogenic causing anaemia. Tissue changes observed at the site of attachment in the caecum were sloughing of the caecal mucosa, cellular infiltration around the parasitised area and hyper activity of goblet cells.

The prepatent period of Strongyloides papillosus

has been worked out for the first time using kids. Following oral infection the prepatent period was 6-7 days. It was found that massive dose of 1 lakh or more of larvae as tried by other workers were not necessary to set up an experimental infection with S. papillosum. Infection could, successfully, be set up even with 7000 larvae through oral route.

Transmission of Necascaris vitulorum of calves to heterologous hosts like goats and guinea pigs was attempted. The eggs of the worm could satisfactorily be cultured in 0.1% formalin and the larvae completed development in 10 days. Repeated attempts to infect kids with Necascaris vitulorum of calves did not meet with success, either transplacentally or orally. In guinea pigs too, N. vitulorum failed to attain sexual maturity.

Calves could not be infected, post-natally with Necascaris vitulorum.

In a cross-transmission experiment, calves were found to be refractory to Oesophagostomum columbianum of goat origin.

The prepatent period of Oesophagostomum columbianum in kids has been determined to be 40 days.

Treatment trials with 4 anthelmintics viz. Oxibendazole, thiophanate, Albendazole and Parbendazole were carried out to assess their anthelmintic efficacies, ovicidal property, influence on the weight gain of treated animals and toxicity to animals. The four drugs were also tested against live Haemonchus contortus to note their in vitro action.

Against monospecific infection of Trichuris globulosa in experimentaly infected kids, the efficacies of Oxibendazole, thiophanate, Albendazole and Parbendazole at the recommended doses of 10 mg, 50 mg, 10 mg and 30 mg/kg body weight respectively were found to be 48.6%, 41%, 47.3% and 49.3% respectively. With double the recommended doses their efficacies were found to increase to 100%, 89%, 96% and 100% respectively, without manifestation of any toxic symptoms in treated kids.

The efficacies of Oxibendazole, and Albendazole at the recommended doses (10 mg and 10 mg/kg body weight respectively) were found to be 100% against Haemonchus contortus, Trichostrongylus colubriformis, Bunostomum trigonocephalum, Oesophagostomum columbianum, O. asperum and Strongyloides papillosus. Thiophanate at the recommended dosage, (50 mg/kg body weight) was also 100% effective against all the nematodes mentioned above.

except Haemonchus contortus, against which it was only 97% effective at that dosage. Parbendazole at the recommended dosage schedule (30 mg/kg body weight) was 100% effective against the nematodes with the exception of Bunostomum trigonocephalum, against which only 86.6% efficacy was noticed.

Against immature nematodes of gastro-intestinal tract Oxibendazole and Albendazole gave 100% efficacy and Parbendazole and thiophanate showed 85% and 74% effectivity respectively at the recommended doses.

In in vitro studies the anthelmintic efficacy of Oxibendazole was found to be superior to that of all the other three. Activity of thiophanate and Parbendazole was inferior to Albendazole and the former two drugs had matching efficacies, in in vitro trials against Haemonchus contortus.

With regard to the ovicidal property, Oxibendazole was ovicidal in 6 hours after administration, Albendazole in 8 hours, thiophanate in 9 hours and Parbendazole in 11 hours.

Regarding their influence on the body weight gain of treated goats, Albendazole was found to be superior to all the other three anthelmintics, closely followed

by Oxibendazole. Parbendazole and thiophanate were inferior to others.

Judging on the basis of over all efficacies Oxibendazole and Albendazole were found to be superior to thiophanate and Parbendazole.

Treatment trials with Oxibendazole, Albendazole and thiophanate against gastro-intestinal nematodes of goats have not been attempted earlier to this report.

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STUDIES ON CERTAIN GASTRO-INTESTINAL NEMATODES WITH SPECIAL REFERENCE TO THOSE FOUND IN GOATS

By

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ABSTRACT OF A THESIS

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ABSTRACT

Life history of Trichuris globulosa has been elucidated for the first time using kids as experimental animal. Both free living and parasitic stages have been described in detail with illustrations. The prepatent period of Trichuris globulosa was found to be 85-89 days. T. globulosa failed to develop in guinea pig on experimental transmission. Haematology and histopathology of trichuriasis in kids experimentally infected with T. globulosa have been studied for the first time and heavy infection with the worm was found to cause anaemia and pathological changes in caecum of the host. Prepatent period of Strongyloides papillosus in kids infected orally with 7000 larvae has been determined for the first time to be 6-7 days. Neoascaris vitulorum of calves has been found to be not transferrable to goats either transplacentally or orally. In guinea pigs N. vitulorum failed to attain sexual maturity. Calves could not be infected with N. vitulorum post-natally. Oesophagostomum columbianum of goats has been found to be not transferable to calves. Prepatent period of O. columbianum in kids infected experimentally was found to be 40 days.

Comparative efficacy of 4 anthelmintics viz. Oxibendazole, thiophanate, Albendazole and Parbendazole was assessed by conducting treatment trials. Against monospecific infection of Trichuris globulosa in experimentally infected kids the efficacies of Oxibendazole, thiophanate, Albendazole and Parbendazole at the recommended doses of 10 mg, 50 mg, 10 mg and 30 mg/kg body weight respectively were found to be 48.6%, 41%, 47.3% and 49.3% respectively. At double the recommended doses their efficacies were found to increase to 100%, 89%, 96% and 100% respectively. Even at double the recommended doses the anthelmintics were found to be well tolerated by the kids. Oxibendazole and Albendazole at the rate of 10 mg and 10 mg/kg body weight respectively were found to be 100% effective against Haemonchus contortus, Trichostrongylus colubriformis, Oesophagostomum trionocephalum Oesophagostomum columbianum, O. asperum and Strongyloides papillosus. Thiophanate at the recommended dosage (50 mg/kg body weight) was also 100% effective against all the nematodes mentioned above except Haemonchus contortus against which it was only 97% effective at that dosage. Parbendazole at the recommended dosage schedule (30 mg/kg body weight) was 100% effective against the nematodes