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PRELIMINARY REPORT ON THE GOLDEN HAMSTER AS A DEFINITIVE HOST OF *TAENIA SOLIUM* LINNAEUS, 1758 AND *TAENIA SAGINATA* GOEZE, 1782

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Abstract

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Injections of an immunosuppressant drug, methyl prednisolone acetate, increase the susceptibility of golden hamsters to the adult stage of *Taenia solium* Linnaeus, 1758. At dosage rates of 10, 5, 2 and 1 mg per week, 73,9, 80,0, 64,3 and 25 per cent respectively of the hamsters became infested. Both male and female genitalia develop but egg production does not occur.

When hamsters are treated with 10 mg of the drug 25 per cent became infested with the adult stage of *Taenia saginata* Goeze, 1782.

Introduction

Investigations on the larval stages of the human tapeworms *Taenia solium* Linnaeus, 1758 and *Taenia saginata* Goeze, 1782 are dependent on a constant and regular supply of ova of these parasites. The supply of these ova is, however, erratic as gravid segments can only be collected from infested humans prior to treatment or at autopsy. It is therefore essential that alternative sources of infestive material be found. Cadigan, Stanton, Tanticharoenyos & Chaicumpa (1967) have shown that *T. solium* can establish itself and become patent in the lar gibbon, *Hylobates lar* (Linnaeus, 1771). Gnezdilov (1957) found that it may establish itself in the golden hamster, *Mesocricetus auratus* (Waterhouse, 1839), but in this host the strobilae show no differentiation of the genitalia. Verster (1965) was able to infest the chacma baboon, *Papio ursinus* (Kerr, 1792), with *T. solium* but slaughtered the host before adult worms were present. Thus far *T. saginata* is known to attain patency only in man. Attempts by Verster (1965) to establish this species in the chacma baboon and in the vervet monkey, *Cercopithecus aethiops* (Cuvier, 1821), were also unsuccessful.

As golden hamsters are readily available and easy to handle, the possibility of using them as definitive hosts of *T. solium* and *T. saginata* was considered worth investigating. Since Gnezdilov (1957) found that the strobilae which developed in hamsters were sterile it was decided to treat hamsters with varying amounts of an immunosuppressive compound in an attempt to assist the development of fertile *T. solium*. A preliminary trial showed that immunosuppressive compounds increased the hamster's susceptibility to infestation with *T. solium*. It was therefore decided to infest similarly treated animals with *T. saginata*.

Sweatman & Williams (1962) showed that *Taenia ovis* (Cobbold, 1869), which usually parasitizes canines, may establish itself and become patent in cats which are fed horse meat. It was thus decided to investigate the effect of feeding hamsters with chopped beef in addition to their usual rations.

Materials and Methods

1. *T. solium*

Each of 132 hamsters was infested with three or four *Cysticercus cellulosae* from pork. Thereafter the animals were divided into five groups. Once a week hamsters in four groups were injected subcutaneously with the immunosuppressant drug methyl prednisolone acetate* as follows: Group 1, 10 mg; Group 2, 5 mg; Group 3, 2 mg and Group 4, 1 mg respectively. The antibiotic Protericline R** at a concentration of 20,8 mg per 100 ml was added daily to their water. The diet of these animals consisted of rat cubes and grain. The animals in Group 5 received neither suppressant nor antibiotic; chopped beef was added to their diet.

Eight animals in Group 1 were killed and examined 10 days after infestation. The majority of the remaining 124 animals were autopsied when they died naturally but in some instances the experiment was terminated when only a few animals remained.

2. *T. saginata*

Sixteen hamsters were each fed three *C. bovis* from beef and subsequently treated the same as Group 1. These animals were examined 10 days after infestation.

Results

The number of hamsters in each group and the number found to be positive at autopsy are summarized in Table 1. In Table 2 the number of *T. solium* recovered is expressed as a percentage of the number of cysticerci dosed. One of the four animals which became infested with *T. saginata* had two worms while the remaining three had one each.

The susceptibility of hamsters to infestation with *T. solium* shows a direct correlation with the amount of methyl prednisolone acetate injected up to a maximum of 5 mg per week. From these data it is clear that hamsters are less susceptible to infestation with *T. saginata* (25%) than to *T. solium* (74%) even at the high dosage rate of 10 mg per week of methyl prednisolone acetate.

Table 1 *The number of hamsters infested with* T. solium *or* T. saginata

Group	Dosage of methyl prednisolone acetate	No. of hamsters infested	Hamsters positive	
			Number	%
T. solium				
1	10 mg	46	34	73,9
2	5 mg	30	24	80,0
3	2 mg	28	18	64,3
4	1 mg	8	2	25,0
5	0†	20	7	35,0
T. saginata	10 mg	16	4	25,0

*Depo-Medrol, Upjohn
**Meds Laboratories
†Meat added to diet

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TABLE 2 *Number of* T. solium *recovered expressed as a percentage of the number of* C. cellulosae *dosed*

Group	Percentage Recovery					
	100%	75%	66%	50%	33%	25%
Group 1*	10	2	8	2	10	1
2*	9	7	2	3	1	1
3	6	3	0	0	0	9
4	1	0	0	0	1	0
5	3	0	1	2	0	1

*The number of worms in one animal in Group 1 and one in Group 2, could not be determined as only fragments of strobila and no scolices were recovered.

It is not known whether hamsters which receive less than this dose would be susceptible to infestation with *T. saginata*.

The rate at which genitalia develop is also correlated with the amount of methyl prednisolone acetate used, but in addition is dependent on the number of worms present in an individual. In Group 1 primordia of the genital ducts were first visible on Day 15. On Day 21 three worms were recovered from each of two hamsters and two worms from a third animal. Primordia of the genital ducts were present in the worms from one and testes were present in those of the other hamster which had three worms. The reproductive organs of the cestodes from the individual with two worms, however, were fully developed. In Group 2, four worms were recovered from an animal on Day 21. In these the genital ducts and the testes were differentiated, but the female reproductive organs were absent. In this group fully developed sexual organs were present in a single specimen recovered on Day 36. In Group 3 two worms were recovered from each of five hamsters which died at different times between Day 14 and Day 26. In these specimens primordia of the genital ducts were present. In this group fully developed sexual organs were present in three worms recovered from another hamster which died on Day 42. In Group 4, *T. solium* was recovered from only two of eight hamsters when this trial was terminated on Day 74. In these the sexual organs were fully differentiated. On Day 58 genital ducts and testes were present in cestodes recovered from Group 5 which did not receive any immunosuppressive treatment, but had meat included in their rations.

The survival time of the hamsters following infestation and treatment with methyl prednisolone acetate was in indirect proportion to the amount of drug injected in excess of 1 mg per week. In Group 1, which received 10 mg of the drug, the first death occurred on Day 8 and none survived for more than 35 days. In Group 2 (5 mg) the first animal died on Day 13 and the last one on Day 48; in Group 3 (2 mg) the first death was on Day 10 and the last on Day 69. The animals in Group 4 (1 mg) were killed on Day 74 when the experiment was terminated. In Group 5, which received no immunosuppressive treatment, deaths occurred on Day 4, 26, 35 and 37 respectively; the remaining 16 animals were autopsied on Day 58.

The inclusion of chopped beef in their diet did not appear to have an appreciable effect on the susceptibility of hamsters to infestation with *T. solium,* nor did it result in the worms developing more rapidly than those from Group 4.

DISCUSSION

Gnezdilov (1957) recovered *T. solium* from 15 of 31 golden hamsters (48,4%) which were fed from 5 to 100 *C. cellulosae* each. On Day 32 primordia of the female genital ducts were present in one specimen which was 200 mm long. The remaining 120 worms, which varied in age from 2 to 60 days and from 2 to 150 mm in length, did not show any sexual differentiation.

It is evident from these experiments that suppression of the host's immune mechanism appreciably increases the golden hamster's susceptibility to infestation with *T. solium* and also results in an increase in the rate at which genitalia are differentiated; egg production, however, does not occur. The failure of these worms to become fertile may be due to any one of a variety of factors influencing spermatogenesis or oogenesis, but is more probably due to the worms being too young. According to Yoshino (1934) *T. solium* becomes patent in 62 to 72 days in man while Cadigan *et al.* (1967) recovered ova from the faeces of a lar gibbon 52 days after infestation. In hamsters treated with 10 mg and 5 mg methyl prednisolone acetate per week, the genitalia appear to be fully developed on Day 21 and Day 36 respectively; none of the animals in these two groups, however, survived for longer than 35 and 48 days respectively.

The inclusion of chopped beef in the diet of the hamsters did not increase their susceptibility to infestation with *T. solium*. The worms recovered from these hamsters showed some differentiation of genitalia, but the rate at which this occurred was retarded in comparison with those of Groups 1 to 4.

Although methyl prednisolone acetate had the desired effect of increasing the golden hamster's susceptibility to *T. solium,* it also increased their susceptibility to infection which resulted in an earlier mortality. It is essential that other substances be tested to find one which will suppress the immune mechanism sufficiently for *T. solium* to establish itself and become patent, but will not lower their resistance to infection to such a marked extent.

SUMMARY

Injections of an immunosuppressant drug, methyl prednisolone acetate, increase the susceptibility of golden hamsters to infestation with adult *Taenia solium* Linnaeus, 1758. Similarly treated hamsters appear to be less susceptible to infestation with adult *Taenia saginata* Goeze, 1782.

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