

# Incidence and Morphology of *Cysticercus pisiformis* (*Taenia pisiformis* Bloch 1780: Taeniidae) Collected from Rabbits in Korea

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## 토끼에서分離된豆狀囊尾蟲의感染實態調査 및形態學的觀察

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抄錄: 國內에서 飼育하고 있는 토끼중 市場으로부터 購入되어 家畜衛生研究所에서 여러가지 研究 目的으로 供試되고 있는 實驗用 토끼를 대상으로하여 實驗前 自然斃死 또는 試驗終了後 廢棄되는 때에 剖檢하여 豆狀囊尾蟲(*Taenia pisiformis*)의 幼生期인 豆狀囊尾蟲(*Cysticercus pisiformis*)에 대한 感染實態 樣相을 調査하였으며 蟲體內部的 頭部를 觀察한바 그 結果를 要約하면 다음과 같다.

1. 1981年 7월부터 1986年 6월까지 5個年間 조사된 總 213首의 토끼중 46首가 感染되어 平均 21.6%의 感染率을 나타 냈으며 年次別로 增加되는 추세를 認定할 수 있었다.

2. 季節別 및 性別에 따른 差異는 認定되지 아니 하였으나, 品種別로는 短毛種(28.4%)에서 長毛種(6.2%)보다 높았다.

3. 寄生部位別로는 肝에의 寄生이 가장 많았으며, 장간막, 胃, 腎臟의 順이었는데 두장기에 복합 감염된 例도 있었다.

4. 分離된 蟲體는 길이(平均 7.04mm)가 폭(平均 4.62mm)보다 1.5倍 가량 길었으며 內部에는 頭部(scolex)가 形成되어 있었다.

5. 頭部에는 4個의 吸盤이 붙어있고 上部中央에 口器突出物(rostellum)이 있으며 內側(큰 것)과 外側(작은 것) 2列로 갈퀴리(hooks)가 정렬되어 있었는데, 큰 것은 250 $\mu$ m 정도, 작은것은 150 $\mu$ m 정도이었다.

## Introduction

Rabbits are usually used as the experimental animals in many kinds of researches on the biological and immunological studies. However, not so many noticeable references on the parasitological reports are available in Korea except the manuscripts presented by Jang *et al.* (1976) and Lim *et al.* (1964).

Most of the rabbits using as the experimental

animals in Korea is not produced from the specialized farms for the laboratory animals, but purchased from the non-specialized farmers or from the markets without any care. Therefore, it is recognized that such rabbits have no value anymore as the genuine experimental animals in some cases. Recently, author has also been experienced that the rabbits purchased from the markets randomly had died suddenly with unknown causes before the main experi-

ments commenced.

In this manuscript, the results of the survey on the recent incidence of *Cysticercus pisiformis* and the morphological findings of the cysts collected are reported. In fact, *C. pisiformis* is the larval stage of the tapeworm *Taenia pisiformis*, however the incidence of *T. pisiformis* in the final hosts, such as dogs, cats, and wild canivores is not still clear in Korea even it is available some reports formerly published long time ago or partly reported without details. (Lee, 1978; Jang *et al.*, 1976; Kang, 1967; Lim *et al.*, 1964).

### Materials and Methods

**Rabbits Investigated:** Most of the rabbits used as the target host animals in this study was selected from the animals readily purchased from the animal markets unknown regions and died suddenly before the main experiments. The live rabbits were also included in this investigation and they were slaughtered as soon as the original experiments finished, such as, immunological studies or safety experiments and so forth.

**Specimen Collection and Preservation:** The abdomens of the rabbits were opened and the cysts were collected from the organs parasitized. Then, the specimens collected were fixed and preserved in the bottles filled with 10% formalin.

**Measurements and Descriptions:** The specimens collected were observed in naked eyes first and were observed with a binocular stereoscopic microscope. The sizes and basic morphological descriptions were

measured and described, respectively, by means of ocular and stage micrometers. Later, the cysts were brocken out by means of pressure between two slide glasses and observed under the trinocular microscope for the fine morphological findings and photography on the scolexes, rostellata and hooks.

### Results and Discussion

**Incidence of *Cysticercus pisiformis*:** A total of 213 rabbits was investigated from July 1981 to June 1986 and the overall infection rate was revealed as high as 21.6%, 46 infected out of 213 investigated. And the incidence was no relation with sexes of the host animals, 23.0% in the females (20 out of 87) and 21.6% in the males (26 out of 126), but it was recognized that the incidence was higher in the short-haired New Zealand White (28.4%; 42 out of 148) than in the long-haired Angola (6.2%; 4 out of 65) as shown in Table 1.

The secular trend of the incidence of *C. pisiformis* in rabbits in Korea was analyzed according to Spiegel and Boxer (1972), and the equation (trend line)  $Y=7.45X+5.87$ , when  $X=0(1981)$  to  $5(1986)$ , was obtained as shown in Table 2.

During the investigation a total of 1,425 cysts was collected so individual infection numbers were a mean 6.69 cysts per host with range, minimum 1 to maximum 23. It was also recognized that the liver was the most frequently parasitized organ (39.1%; 102 out of 261), and the mesentery, the stomach, the kidney and others, respectively. Among the 261 positive cases, 48 cases were infected doubly in two

**Table 1.** Incidence of the Larval *Cysticercus pisiformis* in the Experimental Animal Rabbits in Korea, '81 to '86

Host animals	No. of rabbits investigated	No. of rabbits infected	Infection rate (%)
<b>Breeds</b>			
-Short-haired N. Z. W.	148	42	28.4
-Long-haired Angola	65	4	6.2
<b>Sexes</b>			
-Females	87	20	23.0
-Males	126	26	21.6
<b>Total (Mean)</b>	213	46	(21.6)

**Table 2.** Secular Trend of the Incidence of *Cysticercus pisiformis* in Rabbits in Korea, '81 to '86

Year investigated	Numerals for year (X)	No. of rabbits investigated	No. of rabbits infected	Infection rate, % (Y)	Estimation for $Y_{-}(Y')$
1981	0	32	2	6.3	5.9
1982	1	56	8	14.3	13.3
1983	2	44	7	15.9	20.8
1984	3	37	12	32.4	28.2
1985	4	25	9	36.0	35.7
1986	5	19	8	42.1	43.1
Total (6 years)		213 heads	46 heads	21.6 (Mean)	21.6 (Mean)

**Table 3.** Statistical Data on the Cysts, *Cysticercus pisiformis* Collected from Rabbits in Korea, '81 to '86

Item	Data	
No. of rabbits investigated	213	
No. of cysts collected	1,425	
No. of cysts per host	(Mean)	6.69
	(Min.)	1
	(Max.)	23
Organs parasitized	No. of cases (%)	No. of cysts
-Liver	102(39.1)	705
-Mesentery	84(32.2)	543
-Stomach	39(14.9)	121
-Kidney	24( 9.2)	39
-Others	12( 4.6)	17
Total	*261(100)	1,425

\* 48 cases (261-213) were doubly infected in two organs.

organs(Table 3).

**Descriptions of *Cysticercus pisiformis*:** As shown in Table 4., a total of 72 cysts collected was measured and observed. The mean size of the cysts measured was 7.04mm in length and 4.62mm in width. There was no difference in sizes according to the host organs parasitized (Figs. 1 to 3).

The scolexes, head parts, were identified in the cysts and have four suckers (Figs. 4., 5 and 8. to 11). There was a rostellum in the center top of the scolex with two rows of hooks (Fig. 6) and the hooks were divided into two types, such as, the large-type inner hooks measured as mean 250  $\mu$ m in length (Fig.12) and the small-type outer hooks measured as mean 150  $\mu$ m in length (Fig. 13). The details of the hooks such as the blade, the guard and the handle will be reported in another manuscripts

with the comparison to any other cestodes to be published later.

Actually, *C. pisiformis* in rabbits is the larval stage of the tapeworm *Taenia pisiformis* in the final host, the dog, the fox, the wild canivora and the cat. The adult tape worm is up to 200cm in length and the infections damage severely to the liver and death of the host can result in some cases. (Gemmell and Johnstone, 1977; Dey-Hazra, 1976; Cheng, 1964).

**Classification and Identification of *Cysticercus pisiformis*:** The Class Eucestoda regarded as the true cestodes contains 15 Orders, of which seven Orders contain important parasites of domestic animals, man and fish (Soulsby, 1982). The Order Cyclophyllidea is the most important in veterinary field (Soulsby, 1965).

**Table 4.** Statistical Data on the Cysts Investigated and the Hooks of the Rostellum in *Cysticercus pisiformis*

Item	Data	
No. of cysts investigated	72 (Selected randomly)	
Measurements of the cysts		
-in length	(Mean)	7.04 mm
	(Min.)	4.05 mm
	(Max.)	11.66 mm
-in width	(Mean)	4.62 mm
	(Min.)	3.28 mm
	(Max.)	6.84 mm
No. of suckers on a cyst	4	
No. of hooks on a rostellum	(Mean)	43.6 in two rows
	(Min.)	36
	(Max.)	48
	(Mode)	44
Measurements of the hooks in length		
-Large-type inner hooks	(Mean)	250 $\mu$ m
	(Min.)	223 $\mu$ m
	(Max.)	291 $\mu$ m
-Small-type outer hooks	(Mean)	150 $\mu$ m
	(Min.)	134 $\mu$ m
	(Max.)	178 $\mu$ m

**Table 5.** Classification of *Cysticercus pisiformis* (*Taenia pisiformis*) Collected from Rabbits

Classification scheme	Scientific name
Kingdom	ANIMALIA
Phylum	PLATYHELMINTHES
Class	EUCESTODA (Southwell 1930)
Order	TAENIIDEA (Wardle, McLeod, Radinovsky 1974)
Family	TAENIIDAE (Ludwig 1886)
Genus	<i>Taenia</i> (Linnaeus 1758)
Species	<i>T. pisiformis</i> (Bloch 1780)
	(Synonym; <i>T. serrata</i> )
	(Larval form; <i>Cysticercus pisiformis</i> )

However, Wardle *et al.* (1974) have proposed a new classification scheme for the tapeworms including the taxon Order Taeniidea. In this manuscript, the author follows the opinion of Soulsby (1982) and the classification and identification scheme is summarized as shown in Table 5.

The specimens used in this investigation were identified according to the opinions of Tanaka (1979), Georgi (1978), Sengbusch (1977), Heath (1971), Esch and Self (1965) and Verster (1969). It is di-

fferent species from the hydatid cyst, *Echinococcus granulosus* collected from bovine host (Jang and Oh, 1974), and from *T. taeniaformis* (Kang, 1986), from *Moniezia expansa* (Kates and Goldberg, 1951), from *M. benedeni* (Kang, 1986) and from any other taniid parasites (Lloyd, 1979).

### Summary

A total of 213 rabbits was investigated from July 1981 to June 1986, for the survey on the incidence

of *Cysticercus pisiformis* infections and the morphological characteristics were observed for the descriptions on the scolexes of the cysts collected. The results obtained were summarized as follows;

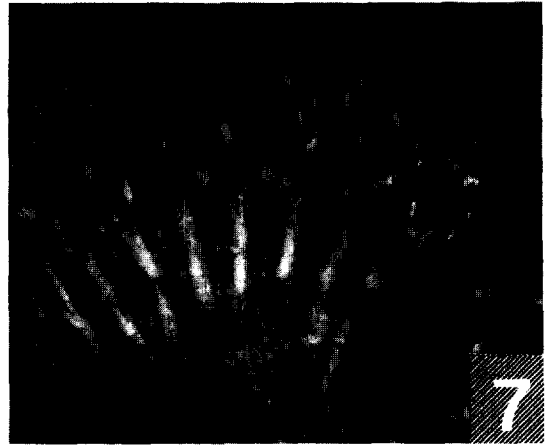
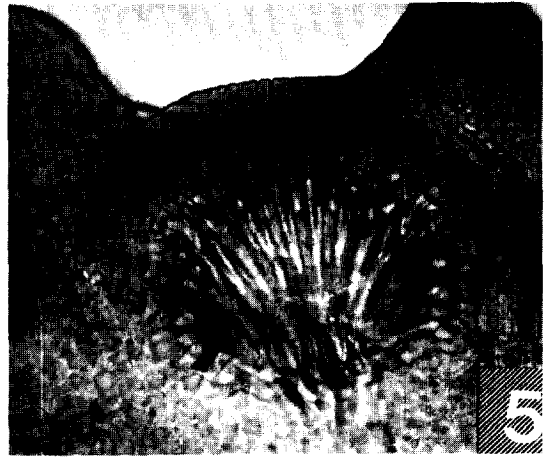
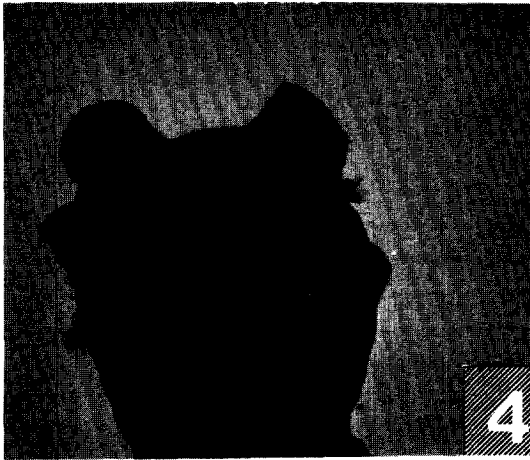
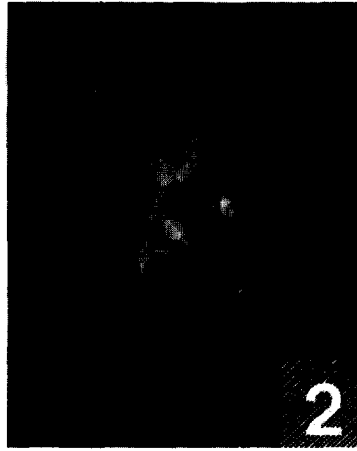
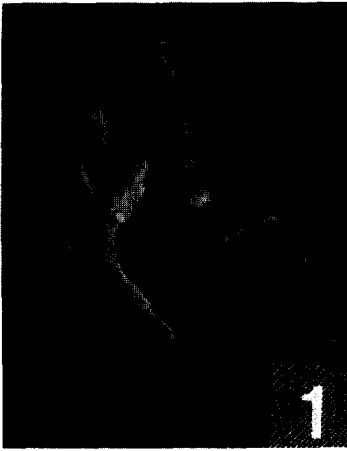
The overall infection rate was revealed as high as 21.6% and it increased annually with the secular trend equation  $Y=7.45X+5.87$  when,  $Y$ =infection rate estimated,  $X$ =year 0(1981) to 5 (1986). The incidence was no relation with the sexes of the host, but it was higher in the short-haired New Zealand White than in the long-haired Angola. It was also revealed that the liver was the most parasitized organ (39.1%) and that 48 cases were double infections in two organs, such as the mesentery, the stomach or

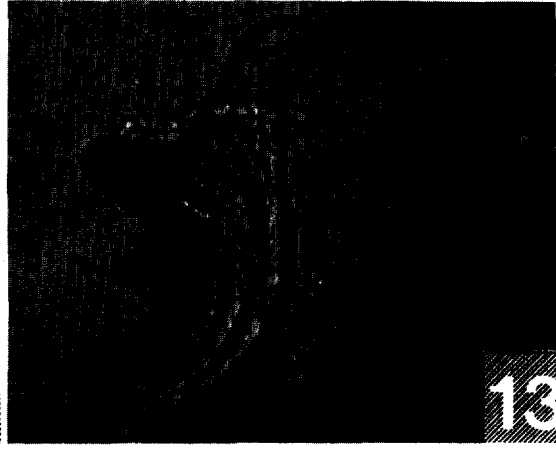
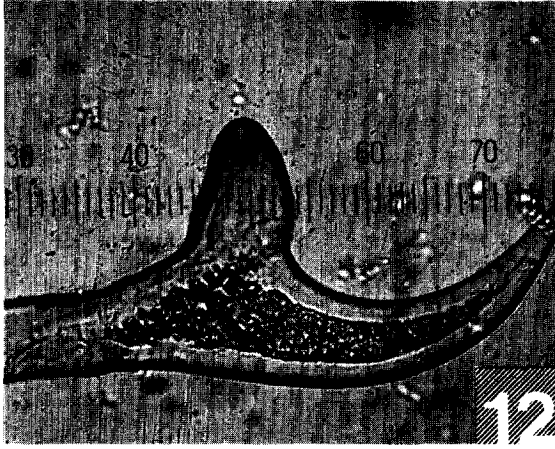
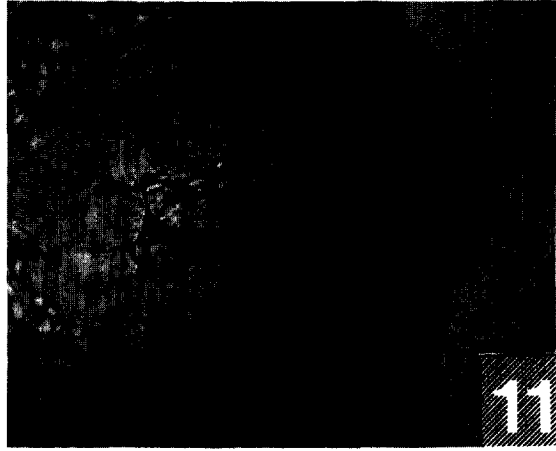
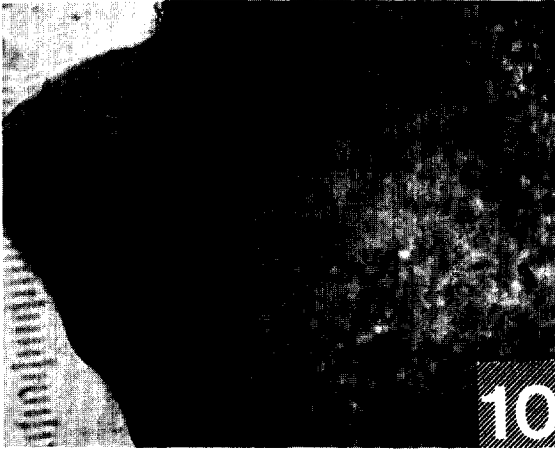
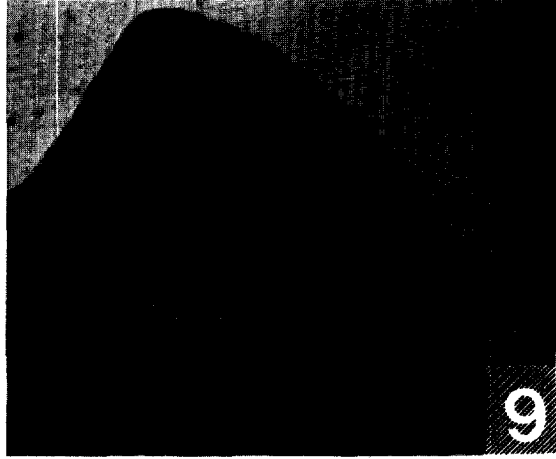
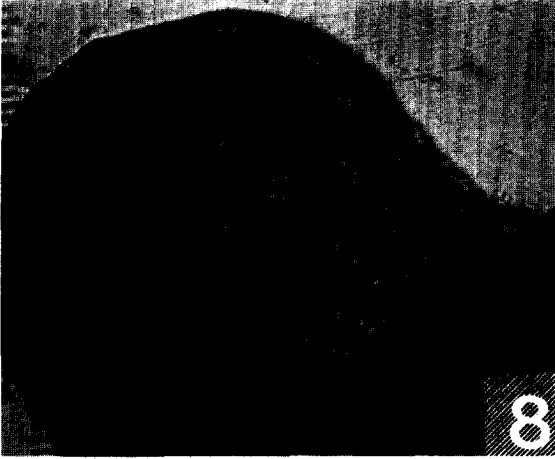
the kidney. The mean size of the cysts measured was 7.04 mm in length and 4.62 mm in width. There were four suckers and a rostellum on the top of the scolex identified inside the cyst. The hooks were arranged in two rows, the large-type inner hooks (mean 250 $\mu$ m in length) and the small-type outer hooks (mean 150  $\mu$ m in length).

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### Legends for Figures

- Figs. 1 to 3.** *Cysticercus pisiformis*; The larval stage (cysts) of *Taenia pisiformis* parasitizing to the external surface of the stomach (Fig. 1), to the abdominal surface of the liver (Fig. 2) and to the mesentery (Fig. 3) of the host rabbit, respectively. (Direct photography).
- Fig. 4.** The scolex of *C. pisiformis* showing the rostellum and four suckers. (Lugol's biostaining,  $\times 40$ ).
- Fig. 5.** The joint area of the rostellum and the suckers showing the two rows of hooks. (Lugol's biostaining,  $\times 100$ ).
- Fig. 6.** The hooks arranged in two rows, large and small types, totally 44 hooks in numbers on the rostellum. (Lugol's biostaining,  $\times 200$ ).
- Fig. 7.** The numerous spore-like cells seen in the vicinity of the neck part. (Lugol's biostaining,  $\times 200$ ).
- Figs. 8 to 11.** The enlarged aspects of the suckers, the hind-left sucker (Fig. 8.), the hind-right sucker (Fig. 9), the front-left sucker (Fig. 10) and the front-right sucker (Fig. 11). (Lugol's biostaining,  $\times 200$ ).
- Figs. 12 to 13.** The enlarged aspects of the hooks on the rostellum, the large-type inner hook (Fig. 12.) and the small-type outer hook (Fig. 13.). (Lugol's biostaining,  $\times 400$ ).





## References

- Cheng, T.C. (1964) The Biology of Animal Parasites. Saunders, Philadelphia and London, p. 605.
- Dey-Hazra, A. (1976) The efficacy of Droncit praziquantel against tapeworm infections in dog and cat. *Vet. Med. Rev.*, 2:134~141.
- Esch, G.W. and Self, J.T. (1965) A critical study of the taxonomy of *Taenia pisiformis* Bloch 1780, *Multiceps multiceps* Leske 1780 and *Hydatigera taeniaformis* Batsch 1786. *J. Parasitol.*, 51:932~937.
- Gemmell, M.A. and Johnstone, P.D. (1977) Experimental epidemiology of hydatidosis and cysticercosis. *Adv. Parasitol.*, 15:311~369.
- Georgi, J.R. (1978) Parasitology for Veterinarians. Saunders, Philadelphia, London and Toronto, p. 386.
- Heath, D.D. (1971) The migration of oncospheres of *Taenia pisiformis*, *T. serialis* and *Echinococcus granulosus* within the intermediate host. *Intl. J. Parasitol.*, 1:145~152.
- Jang, D.H. and Oh, M.Y. (1974) Epizootiological study of *Echinococcus granulosus* (Batsch 1786) Rudolphi 1805 in Jeju-do. 1. Incidences of bovine hydatid cyst and its speciation. *Korean J. Vet. Res.*, 14:73~76.
- Jang, D.H., Seo, I.S., Cheong, C.K. and Sung, J.K. (1976) Survey on diseases of the laboratory animals. 1. Parasitic infection and infestation. *Seoul Nat. Univ., J. Vet. Sci.*, 1:85~113.
- Kang, H.J. (1967) Survey of internal parasites in cats in Western Gyeongnam area. *Res. Rep., Jinju Agr. Coll.*, 6:92.
- Kang, Y.B. (1986) Scanning electron microscopy on the surface fine structures of the cestodes, *Moniezia benedeni* Moniez 1879 (Anoplocephalidae) and *Taenia taeniaformis* Batsch 1786. *Korean J. Vet. Publ. Hlth.*, 10:39~47.
- Kates, K.C. and Goldberg, A. (1951) The pathogenicity of the common sheep tapeworms, *Moniezia expansa*. *Proc. Helminth. Soc. Washington*, 18:87~101.
- Lee, H.S. (1978) A survey on helminth parasites of cats in Gyeongbuk area. 1. Cestodes, nematodes and trematodes. *Res. Rep., Gyeongbuk Nat. Univ.*, 26:625.
- Lim, Y.M., Lee, B.D. and Kong, J.H. (1964) Survey of endoparasites in the domestic rabbits of Korea. *Res. Rep. Off. Rur. Dev.*, 7:75~78.
- Lloyd, S. (1979) Homologous and heterologous immunization against the metacestodes of *Taenia saginata* and *Taenia taeniaformis* in cattle and mice. *Z. parasitenk.*, 60:87~96.
- Sengbusch, H.G. (1977) Review of oribatid mite-anoplocephalan tapeworm relationship (Acari; Oribatei; Cestoda; Anoplocephalidae). *Proc. Symp. East. Branch Entomol. Soc. Am.*, 87~102.
- Soulsby, E.J.L. (1965) Textbook of Veterinary Clinical Parasitology. 1. Helminths. Blackwell Scientific, Oxford, p.1120.
- Soulsby, E.J.L. (1982) Helminths, Arthropods and Protozoa of Domesticated Animals. (7th Ed.), Lea and Febiger, Philadelphia, p. 809.
- Spigel, M.R. and Boxer, R.W. (1972) Schaum's Outline of Theory and Problems of Statistics in SI Units. McGraw-Hill, London. pp.217~240.
- Tanaka, E. (1979) Veterinary Clinical Parasitology (in Japanese). Veterinary Clinical Parasitology Edition Committee, Buneido, Tokyo. pp.386~402, 595~600.
- Verster, A. (1969) A taxonomic revision of the genus *Taenia* Linnaeus 1758. *Onderstepoort J. Vet. Res.*, 37:3~58.
- Wardle, R.A., McLeod, J.A. and Radinovsky, S. (1974) Advances in the Zoology of Tapeworms. Univ. Minnesota Press, Minneapolis, p. 274.