# Activity of Certain Drugs Against the Fringed Tapeworm

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INFORMATION concerning *Thysanosoma actinioides*, the fringed tapeworm of sheep, is unfortunately out of proportion to its common occurrence in the western states. The life cycle of this parasite remains unknown, despite the fact that parasitologists are devoting considerable effort toward detection of an intermediate host and other details of the life history. Meanwhile, any attempt to control the worm will necessarily be directed toward the selection of an efficacious and specific cestocide.

Ryff *et al.*[1,2] have reported favorably concerning the activity of bis (5-chloro-2-hydroxyphenol) methane against the fringed tapeworm, and in a later paper[1,3] have given optimum dosage levels. This compound is synonymous with 2,2′-methylenebis (4-chlorophenol) and 2,2′-dehydroxy-5,5′-dichlorodiphenylmethane.* In addition, compound G-4** is a pharmaceutical grade, and parabis*** is a feed grade containing specified amounts of attapulgus clay.

The critical treatment trials reported herein involve the drug mentioned above and two others, with respect to activity against the fringed tapeworm. They were undertaken for the purpose of helping to formulate an intelligent answer to the many inquiries from West Texas ranchmen regarding treatment for the fringed tapeworm.

A thysanosomacide should meet the following qualifications in order to merit recommendation for use on West Texas ranges: (1) efficacy approaching 100 per cent without toxic manifestations and with one treatment, since the worm apparently produces no symptoms in this area and the only known benefit from the treatment derives indirectly from the packers; (2) activity against the worm without benefit of fasting, which is often costly and will not be practiced by most ranchmen; (3) low cost and compatability with phenothiazine suspension or other vermifuges used for stomach worms, since separate drenching for tapeworms is not economically feasible at the present time.

## METHODS AND MATERIALS

The sheep used in these trials were Rambouillets 1 to 2½ years old and weighing 65½ to 125½ lb. They were maintained on pasture under normal range conditions and were penned for only a few hours at a time for the selection of animals for treatment. Those selected for treatment at any given time were required to be in good health and to have positive fecal samples on the day of treatment. Thysanosoma proglottids characteristically adhere to the moist surface of the fecal pellets and if not distorted are identified without recourse to microscopic examination.

Dosage rates for teniatol* and 2,2′-methylenebis (4-chlorophenol)†† are shown in tables 1 and 2, along with brief observations. Two other drugs were used: 2,2′-methylenebis (4-chloro-6-isopropylphenol)†† and 4,4′-isopropylidenebis (2-isopropylphenol).††

All medicaments were put in hard gelatin capsules and administered by balling gun. Immediately after treatment, the sheep were placed in a concrete stall equipped with a removable screen floor (fig. 1). Incidentally, this floor has proved to be superior in several respects to the wooden slatted floors previously used for parasite studies. It is constructed of an angle-iron frame and flat-rolled expanded metal having diamond-shaped openings approximately 1¾ in. long and ½ in. wide.

Observations regarding post-treatment symptomatology were made during the treatment-necropsy interval, which varied from forty-eight to 144 hours.

## RESULTS

Results are given in tables 1 and 2 for teniatol and 2,2′-methylenebis (4-chlorophenol). Since dosage rates great enough (0.25 Gm. per pound body weight) to produce severe scouring gave insufficient evidence of activity against Thysanosoma by 4,4′-isopropylidenebis (2-isopropylphenol) and 2,2′-methylenebis (4-chloro-6-isopropylphenol), the results are not tabulated. Some activity by the latter was suggested when one autopsy revealed only 4 Thysanosoma, all having strobila less than 3 cm. in length. However, the concurrent diarrhea was so objectionable that higher dosage rates were deemed inadvisable.

## DISCUSSION

The authors are inclined to be cautious when discussing the damage done by fringed tapeworms. Records of sheep investigations carried on at this station for more than thirty years by seven different veterinary workers contain not a single instance of mortality or morbidity attributable to this parasite. Of course, we often observe thickened walls of the common bile duct and apparent occlusion of ducts, not at all contrary to the observations of Allen and Kyles.[1] Nevertheless, we would be unable to list the symptoms of fringed tapeworm infection. Often this worm is blamed for illness or death of sheep when ranchmen or other lay persons make autopsy observations and find nothing of significance to them except the dramatic tapeworm impaction of "that tube that leads from the gall bladder." It remains to be seen from controlled feedlot experiments whether freedom from the infection will be reflected in significant weight differences.

Controls were not used in these trials in the strict sense of the word; *i.e.*, a control animal was not slaughtered at the time each treated animal was destroyed. The reason for this is that the criterion of successful treatment was decided to be complete elimination of the worms from infected sheep. Since we know of no instances which indicate that fringed tapeworms are shed spontaneously, as is the case with Moniezia, this procedure seemed justifiable. However, in order to provide an estimation of the extent of infection, 28 sheep from the same flock were destroyed at intervals during the study. This indicated that 92.9 per cent were infected and that in the infected animals the number of worms ranged from 2 to 38, with an average of 20 per animal.

The extent of diarrhea following treatment was objectionable in all but the mild cases. Successful feeders and shepherds look with much disfavor upon treatments which soften feces beyond the "balled" stage, and drugs which do this are not likely to be widely used in sheep-producing areas.

The trials with 2,2′-methylenebis (4-chlorophenol) and teniatol seem to confirm the findings of Ryff *et al.* with respect to optimum dosage levels, but in addition revealed some instances (specimens 2-158, 1-549, and 1-539) of apparent toxicity (fig.

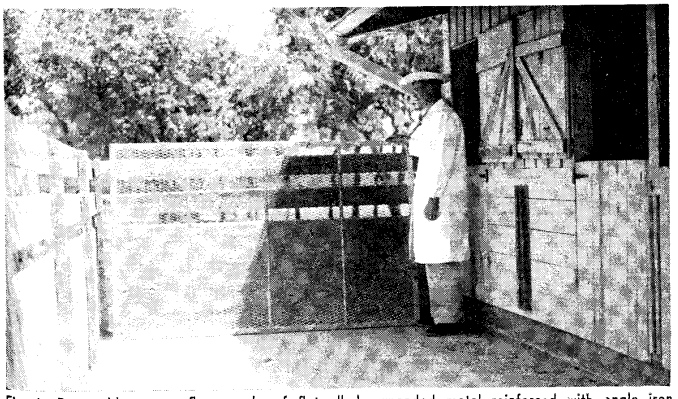

Fig. 1—Removable screen floor made of flat-rolled, expanded metal reinforced with angle iron and pipe.

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*Teniatol and di-phenthane-70 are trade-mark names of the compound and belong to Pitman-Moore Co., Division of Allied Laboratories, Inc., Indianapolis, Ind.

**Produced by Sindar Corporation.

***Produced by Dow Chemical Company, Midland, Mich.

†Supplied by Pitman-Moore Co., Indianapolis, Ind., both as a concentrate powder and as a 15 per cent suspension.

††Supplied by Dow Chemical Co., Midland, Mich., both as a concentrate powder and as a 33.3 per cent solution.

TABLE 1—Dosage Rates for Teniatol, and Brief Observations on Results of Its Use

| Dosage rate | Specimen No. | Antemortem | Treatment-necropsy interval | Necropsy findings |
|---|---|---|---|---|
| *1.5 ml. per 50 lb. body wt. | 0-919 | Moderate diarrhea | 72 hr. | 26 Thysanosoma |
| | 0-932 | Moderate diarrhea | 144 hr. | 16 Thysanosoma (in duodenum only) |
| | 1-549 | Severe diarrhea & inappetence | 72 hr. | 2 Thysanosoma (dead) in gall bladder. Cholecystitis, liver capsule damage, friable liver, peritonitis localized |
| **P-M revised recommendation | 2-153 | Moderate diarrhea | 67 hr. | No Thysanosoma |
| | 2-159 | No symptoms | 120 hr. | 1 Thysanosoma in common bile duct |
| | 1-539 | Moderate diarrhea & inappetence | 92 hr. | 3 Thysanosoma (dead) in gall bladder. Cholecystitis, peritonitis, friable liver |
| †0.25 Gm per lb. body wt. | 2-273 | Moderate diarrhea | 72 hr. | No Thysanosoma |
| | 2-274 | Moderate diarrhea & inappetence | 72 hr. | Areas of hepatic congestion interspersed with areas of cloudy swelling. Two Thysanosoma |
| | 2-275 | Moderate diarrhea | 72 hr. | No Thysanosoma |
| | 2-284 | Moderate diarrhea | 96 hr. | No Thysanosoma |
| | 2-285 | Mild diarrhea | 96 hr. | 22 Thysanosoma |
| | 2-286 | Mild diarrhea | 96 hr. | 1 Thysanosoma |

*In accordance with directions formerly printed on teniatol label.

**For first 25 lb., 15 ml.; 5 ml. for each additional 5 lb. of body weight.

†In accordance with work of Ryff et al.

TABLE 2—Dosage Rates for 2,2'-Methylenebis (4-Chlorophenol) and Brief Observations on Results of Its Use

| Dosage rate | Specimen No. | Antemortem | Treatment-necropsy interval | Necropsy findings |
|---|---|---|---|---|
| 0.045 Gm. per lb. | 1-450 | Moderate diarrhea | 48 hr. | 17 Thysanosoma |
| 0.125 Gm. per lb. | 1-647 | Mild diarrhea & inappetence | 72 hr. | 15 Thysanosoma |
| 0.185 Gm. per lb. | 1-649 | Inappetence | 120 hr. | 9 Thysanosoma |
| 0.20 Gm. per lb. | 2-7 | Moderate diarrhea & inappetence | 72 hr. | 1 Thysanosoma |
| | 2-21 | Moderate diarrhea & inappetence | 96 hr. | No Thysanosoma |
| 0.225 Gm. per lb. | 2-158 | Moderate diarrhea & inappetence | 91 hr. | No Thysanosoma; excessive peritoneal & pericardial fluid; fatty degeneration of liver; cholecystitis, with fibrinous inflammation of adjacent omentum |
| | 2-187 | Mild diarrhea | 78 hr. | 4 Thysanosoma |
| | 1-547 | Moderate diarrhea | 116 hr. | 1 Thysanosoma strobila (distal portion only) in duodenum |
| 0.25 Gm. per lb. | 1-571 | Severe diarrhea | 96 hr. | No Thysanosoma |
| | 1-598 | Inappetence | 84 hr. | No Thysanosoma |
| | 1-617 | Found dead within 20 hr. | 20 hr. | No Thysanosoma Gangrenous pneumonia |
| | 1-635 | Mild diarrhea & inappetence | 92 hr. | No Thysanosoma |





2 and 3). The gall bladders of these specimens were enlarged about three times and the mucous surfaces were inflamed, ulcerated, and, in some areas, necrotic. The first 2 of these specimens revealed localized

Fig. 2—Photograph of serous surface of liver taken from specimen 1-549. Nonadhering capsule indicates damage.

Fig. 3—Photograph of mucous surface of gall bladder, specimen 1-549. Erosions and inflammation are evident.

fibrinous peritonitis. In specimen 1-539 the peritonitis had become diffuse. (Although a matter of speculation, the peritonitis appeared to have originated from the gall bladder.) None of the 3 had resumed eating at the time of autopsy. All remaining animals of the flock from which they were taken are still in excellent health, and none of the sheep treated with ineffective dosage levels exhibited any such pathological changes.

Examination of fecal material collected under the screen floor failed to reveal any complete worms or even chains of proglottids. This suggested disintegration such as shown by Craige and Kleckner[3] in the case of dogs treated with di-phenthane-70.

Efforts to determine compatability of these compounds with phenothiazine were postponed due to the toxic effects noted.

Severity of diarrhea with ineffective levels of the two other compounds precluded testing them at higher levels.

## CONCLUSIONS

Under the conditions imposed by these treatment trials, preparations containing 2,2'-methylenebis (4-chlorophenol) as the active ingredient were efficacious in removal of the fringed tapeworm, *Thysanosoma actinioides*, from sheep. Two other compounds, 2,2'-methylenebis (4-chloro-6-isopropylphenol) and 4,4'-isopropylidenebis (2-isopropylphenol), were unsatisfactory.

Optimum dosage levels of the efficacious compound were found to be the same as reported previously by other workers but, in addition, severe toxic effects were noted in some cases.

Recommendations pertaining to treatment of West Texas sheep for removal of the fringed tapeworm should obviously be tendered with caution at the present time. If 2,2'-methylenebis (4-chlorophenol) is used for this purpose, some scouring, inappetence, and toxic effects may be expected.

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## Physiological Studies of Eructation in Ruminants

The modern conception of bloat is that it is due to a failure of the eructation mechanism and is not due to excess gas formation. The study of bloat, therefore, turns largely on a study of the eructation reflex and the factors which affect it. This was determined mainly by forced air insufflation and direct recording of intraruminal pressure (*Onderstepoort J. Vet. Res.*, in press).

Eructation is a complex, coördinated reflex involving the reticulum, rumen, cardiac orifice, and esophagus. It consists essentially in the movement of free gas from the dorsal rumen forward and downward to the cardia. This is accomplished by:

1) A wave of contraction of the ruminal musculature which starts in the posterior sac and moves forward. This usually follows on, but is distinct from, the backward cycle of contractions designed to mix the ingesta.

2) Clearing of the cardia by relaxation of the reticulum. The efficiency of this phase depends on the degree of filling of the rumen.

3) Opening of the cardiac orifice is brought about by contraction of the pillars of the rumino-reticular fold. The main stimulus for eructation is gas pressure in the posterior dorsal sac of the rumen. Variations found among individual animals indicate that the efficiency of the reflex may depend on hereditary factors.

Factors affecting the reflex are:

*A)* Mechanical

1) Obstruction of the esophagus

2) Frothing of the ingesta

3) Overfilling increases the difficulty of moving the gas over the cardia. Elevation of the hind quarters has a similar effect, while elevation of the fore quarters mitigated the effects of overfilling. Animals with a nonfunctioning reticulum were particularly susceptible to overfilling.

*B)* Alkalosis inhibits the reflex by a central action

*C)* Section of the right ventral branch of the vagus nerve, which supplies the reticulum and abomasum, caused chronic tympany due to inhibition of reticular activity and abomasal distension. Section of the left dorsal branch diminished eructation efficiency temporarily by decreasing the strength of ruminal contractions.

*D)* Distension of either the abomasum or the cecum reflexly inhibits the reticulum and therefore reduces the efficiency of eructation by interfering with clearing of the cardia.

*E)* Drugs and Poisons

1) Causing hypomotility

*a)* Prussic acid. Small doses inhibit contractions with consequent inefficiency of eructation. Doses which produce signs of poisoning cause complete paralysis of the rumen.

*b)* Atropine and histamine completely impaired the reflex even before a total paralysis of the rumen was brought about.

*c)* Adrenalin inhibits the eructation by depressing rumino-reticular activity. Psychic disturbances may parallel the inhibition of the "milk let-down" reflex under similar circumstances.

2) Causing hypermotility

Recommended doses of carbomylcholine and veratrine both cause spastic contractions of the rumen which completely obliterates the rhythmic coördinated movements essential for eructation.—R. W. DOUGHERTY, D.V.M.

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Owls are not blind during the day but prefer to hunt in darkness which protects them from crows, blackbirds, and jays.—*Sci. News Letter, Jan. 3, 1953.*

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The horns of more than 1,000 goats of various breeds were observed for a period of four years. At 1 year of age, a groove encircled each horn. Then an additional groove appeared each year.—*Vet. Bull., Oct., 1952.*

# A Preliminary Report on the Blood Picture of the South American Chinchilla

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THE DEMAND is increasing rapidly for more service from the veterinarian in the field of diagnosis and treatment of the South American chinchilla. The clinical laboratory has a definite place in the diagnosis and intelligent approach to the handling of disease problems in this animal. Before changes can be recognized in the normal picture, the normal must be known, and for this reason these preliminary studies were made on 12 healthy chinchillas.

Blood counts were made by collecting a sample directly from a nick in one of the larger ear veins and smears were made at this time also for making a differential white cell count. Samples were taken as nearly as possible at the same time of day at weekly intervals for twelve weeks in an effort to arrive at a more accurate average.

TABLE 1—Blood Picture of the South American Chinchilla

| Animal (No.) | Erythrocyte ($10^6$ cm.) Range | Average | Hemoglobin (Gm. 100 ml.) Range | Average | Leukocytes ($10^3$ cm.) Range | Average |
|---|---|---|---|---|---|---|
| 1 | 6.50-7.85 | 6.62 | 12.2-13.8 | 13.0 | 7.0-13.0 | 9.0 |
| 2 | 5.60-7.80 | 6.73 | 12.5-13.0 | 12.8 | 7.2-15.6 | 11.1 |
| 3 | 6.76-8.20 | 7.13 | 13.0-13.0 | 13.5 | 9.0-13.0 | 10.8 |
| 4 | 5.80-7.90 | 6.58 | 12.6-13.8 | 13.2 | 6.0-14.9 | 11.2 |
| 5 | 6.20-7.50 | 6.74 | 13.2-14.6 | 13.8 | 5.8-12.8 | 9.6 |
| 6 | 6.85-8.40 | 7.75 | 12.8-14.0 | 13.6 | 5.7-12.0 | 8.8 |
| 7 | 6.00-7.96 | 6.84 | 13.5-14.2 | 13.8 | 5.9-11.8 | 8.1 |
| 8 | 5.81-8.75 | 7.30 | 12.2-13.0 | 12.5 | 6.4-13.0 | 8.7 |
| 9 | 6.18-8.56 | 7.33 | 12.0-14.5 | 13.5 | 6.7-13.2 | 9.3 |
| 10 | 5.70-7.00 | 6.09 | 11.8-13.0 | 12.2 | 7.2-12.0 | 9.1 |
| 11 | 6.40-8.10 | 7.10 | 13.0-14.8 | 14.0 | 6.8-10.0 | 8.1 |
| 12 | 6.80-7.35 | 7.00 | 12.0-13.0 | 12.8 | 5.4- 9.4 | 7.1 |
| Mean | 6.26-7.88 | 6.93 | 12.5-13.8 | 13.2 | 6.6-12.5 | 9.3 |

Erythrocyte and leukocyte counts were duplicated each time a count was made, as well as smears for a differential. Red and white cell counts were not averaged and recorded unless they were reasonably close. Red cells had to be within 600,000 and white cells within 1,200 per cubic millimeter, respectively, to be used.

Differential counts were made by staining with Wright's stain and counting 500 cells to get an average percentage.

TABLE 2—Blood picture of the South American Chinchilla

| Animal (No.) | Leukocytes (%) Neutrophils Range | Ave. | Lymphocytes Range | Ave. | Monocytes Range | Ave. | Eosinophils Range | Ave. | Basophils Range | Ave. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 42-46 | 44 | 51-57 | 52 | 0-3 | 2 | 0-3 | 2 | 0 | 0 |
| 2 | 40-44 | 43 | 50-55 | 53 | 0-4 | 1 | 1-5 | 3 | 0 | 0 |
| 3 | 41-47 | 46 | 49-58 | 51 | 1-3 | 2 | 1-4 | 2 | 0-1 | 0 |
| 4 | 41-48 | 45 | 48-60 | 54 | 0-2 | 1 | 2-3 | 2 | 0 | 0 |
| 5 | 41-50 | 44 | 50-60 | 53 | 1-2 | 1 | 0-3 | 2 | 0-1 | 1 |
| 6 | 39-46 | 42 | 49-55 | 53 | 0-2 | 1 | 0-5 | 4 | 0 | 0 |
| 7 | 41-50 | 48 | 50-54 | 51 | 0-1 | 1 | 0 | 0 | 0 | 0 |
| 8 | 47-53 | 50 | 47-52 | 49 | 0 | 0 | 0-2 | 1 | 0 | 0 |
| 9 | 41-50 | 43 | 51-58 | 53 | 0-3 | 2 | 0-2 | 1 | 0-2 | 1 |
| 10 | 43-47 | 44 | 50-60 | 52 | 0-1 | 1 | 0-5 | 3 | 0 | 0 |
| 11 | 40-48 | 47 | 46-50 | 49 | 0-5 | 2 | 0-3 | 2 | 0 | 0 |
| 12 | 46-54 | 51 | 45-49 | 46 | 0-2 | 1 | 0-5 | 2 | 0 | 0 |
| Mean | 42-48 | 45 | 49-55 | 51 | 0-2 | 1 | 0-3 | 2 | 0-1 | 0 |

The hemoglobin content was determined by using the sodium carbonate method of Karr[2] on the Coleman junior clinical spec-

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