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SECTION MEETINGS	
CLEVELAND	
Western Reserve University	May 14, 1937
DISTRICT OF COLUMBIA	
Georgetown University	May 27, 1937
ILLINOIS	
Chicago University Medical School	June 1, 1937
MISSOURI	
St. Louis University Medical School	May 12, 1937
PACIFIC COAST	
University of California	May 8, 1937
SOUTHERN	
Tulane University	May 21, 1937

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9315

Effects of Alcohol on *Trichinella spiralis*.\*

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William Dock.)

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Since there are reports that the liberal use of alcoholic beverages while ingesting trichinous meat offers protection against infection and since the use of generous quantities of cognac has been advised as therapy in trichinosis,<sup>1</sup> we have investigated this problem by experimentation on rats and by the following *in vitro* studies.

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<sup>1</sup> Lommel, F., *Handbuch der Inneren Medizin*. J. Springer, Berlin, 1925. Vol. 1, p. 1429.

Three white rats, infected 3 months previously with *Trichinella spiralis* obtained from a human diaphragm, were sacrificed, skinned, eviscerated, and passed through a meat chopper. The ground meat was thoroughly mixed. The following *in vitro* experiments were performed with this material.

*Experiment No. I.—Effect of alcohol on digestion.* Five gram quantities of the ground rat meat were placed in each of six 250 ml. glass beakers with 100 ml. of artificial gastric juice.<sup>2</sup> Water was added to the first 3 beakers in quantities of 10, 20, and 30 ml. while absolute ethyl alcohol in similar quantities was added to the remaining 3. All were stirred simultaneously in an incubator at 37°C. according to methods previously described.<sup>2, 3</sup> When examined after 6 hours the mixtures in the first 3 beakers were completely digested, while those in the last 3 containing the various dilutions of alcohol showed only partial digestion. All mixtures were permitted to digest for 18 hours when they were strained through a 60 mesh brass wire sieve into separatory funnels. Portions of undigested meat remained on the sieves of the 3 alcohol mixtures in amounts that increased with the strength of the alcohol. The larvae settled rapidly. The sediment of each was drawn off into separate graduated mixing cylinders and made up to 25 or 50 ml. volume with tap water. After thorough mixing, six 0.1 ml. quantities were pipetted into the depressions of hanging-drop slides where the larvae were readily counted using a magnification of 40 diameters. The total numbers of larvae in the concentrate from each 5 gm. of meat are shown in Table I. The 3 non-alcoholic digests averaged 12,732 living larvae while the number in the alcoholic digests varied from 7,660 to 2,650. In the 9% alcohol only 2% of the larvae were tightly coiled, the remainder were loosely coiled non-motile, pre-

TABLE I.  
Showing Interference of Alcohol with Digestion and Liberation of *Trichinella* in 5 gm. Trichinous Meat.

Sample No.	Gastric Juice Ml.	Water Ml.	Absolute alcohol Ml.	Alcohol actual %	Number of Larvae Found		
					Living	Capsulated	Dead
1	100	10			13,150		
2	100	20			13,550		
3	100	30			11,500		
4	100		10	9.0			7,660
5	100		20	16.6		400	3,600
6	100		30	23.0		790	1,860

<sup>2</sup> McNaught, James B., and Anderson, E. V., *J. Am. Med. Assn.*, 1936, **107**, 1446.

<sup>3</sup> Newman, H. W., DeLamater, J. N., and McNaught, J. B., *J. Lab. and Clin. Med.*, 1936, **22**, 203.

sumably dead. In the 16% strength approximately 10% of the larvae were still encapsulated while in the 23% fully 30% were encapsulated, some with fragments of muscle still adherent, and none of the liberated larvae were active.

It is obvious that alcohol increasingly interfered with the liberation of the larvae by digestion. This is in accordance with the experiments of Blotner,<sup>4</sup> who demonstrated that alcohol destroyed the proteolytic activity of certain gastrointestinal enzymes *in vitro* and *in vivo*. Others<sup>5, 6</sup> have shown that alcohol evokes a flow of gastric juice of high acidity but low digestive power.

*Experiment No. II.—Direct action of alcohol on free trichinella larvae.* Approximately 1000 living trichinella larvae digested free of their capsules were added to each of 10 small test tubes containing 2 ml. of aqueous solutions of ethyl alcohol ranging in strength from 25 to 0.1% in the first 9 tubes with water in the tenth as a control. The strength of alcohol was reduced by half in each tube, *i. e.*, tube 1 contained 25% alcohol, tube 2 contained 12.5%, etc. The tubes were kept in a 37.5°C. incubator except during observations.

The activity of the larvae were readily observed under a magnification of 40 diameters. Living larvae were in tight coils or fairly active. The dead ones assumed a comma shape. For 6 hours there were no changes in the larvae in any of the tubes. At 12 hours all larvae in tube 1 (25% alcohol) were dead. At 24 hours all were dead in tubes 2 and 3 (6.25%). By 48 hours all larvae were dead in the first 5 tubes (1.5%), while at least half were active in each of the last 5 tubes including the control. This type of an experiment was repeated 4 times during a 2 months' period, using trichinella from various rat digests with similar results.

These observations show that trichinella larvae are surprisingly tolerant to alcohol, resisting a concentration of 25% for more than 6 hours and of 12.5% for more than 12 hours. Neither of these concentrations are maintained in the human stomach for such long periods.

*Conclusion.* We conclude that a concentration of 25% alcohol has little direct action on trichinella *in vitro* but that concentrations as low as 9% interfere with the digestive liberation of encysted trichinella.

<sup>4</sup> Blotner, H., *J. Am. Med. Assn.*, 1936, **106**, 1970.

<sup>5</sup> Krueger, L., and MacIntosh, F. A., *Am. J. Dig. Dis. and Nut.*, 1937, **4**, 104.

<sup>6</sup> Babkin, B. P., *Die äussere Sekretion der Verdauungsdrüsen*. 2nd Ed. 402-407, Springer, Berlin, 1928.