INTRODUCTION

THE INCIDENCE of the parasite, *Trichinella spiralis*, in swine has declined in the past several decades. However, the incidence of 1.25 infected pigs per 1,000 reported for the period 1966 to 1970 by Zimmermann and Zinter (1971) still represents the potential of 40 million exposures for humans consuming pork not treated to destroy the trichinae. Because some pork products are designed to be eaten without complete cooking, or may inadvertently be undercooked, it is necessary to provide a rapid and economical means for destroying the trichinae.

Historically, this was accomplished by holding the meat products in freezer storage for various periods (USDA, 1965). Holding times for pieces not exceeding 6 in. in thickness or stored in containers not exceeding 6 in. in depth were specified as 20 days at 5°F, 10 days at -10°F and 6 days at -20°F. For pieces or containers exceeding 6 in. in thickness or depth but not exceeding 27 in., the recommended holding times were 30 days at 5°F, 20 days at -10°F and 12 days at -20°F. These time and temperature relationships were based on studies by Ransom et al. (1920). The problems and economic costs associated with the relatively long-term holding of pork products in freezer storage to insure trichinae destruction represent a serious limitation to this particular procedure.

Augustine (1952) stated that trichinae could be destroyed by lowering the temperature of the meat product immediately to -35°C. Gould and Kaasa (1949) concluded that a temperature of -47°C would destroy trichinae in 2 min. At the time these studies were conducted, however, mechanical refrigeration was the only commercially available form of freezing. To attain these temperatures with conventional, mechanical freezing techniques would have been highly impractical.

With the advent of cryogenic materials, such as liquid nitrogen and liquid carbon dioxide, the attainment of the temperatures indicated became, not only feasible, but practical. This study was instituted to determine the effectiveness of these freezing materials for the destruction of trichinae and the minimum temperatures required to render the product safe for consumption without further treatment.

EXPERIMENTAL

THIS STUDY was conducted by using pork patties made from trichina-infected pork. The trichina-infected pork was obtained from pigs used in another experiment. The experimental pigs were orally infected 1 to 4 months before slaughter with a dose of approximately 300,000 trichinae per pig. The pigs were slaughtered and eviscerated according to conventional procedures. After chilling in a 2°C cooler for a 24-hr period, the carcasses were cut, and the loins, bellies and trimmings boned out and ground through a 19 mm plate. This product was then mixed in a Leland mixer to insure uniform distribution of fat and lean and reground through a 4.8 mm plate. On second grinding, the product was extruded through a Hobart Model 61 patty machine into patties approximately 88 mm square and 9 mm thick. Each patty weighed approximately 110g.

A random sample of the meat mixture was examined for the initial number of trichinae per gram of tissue by the artificial digestion-Baermann technique (Zimmermann et al., 1961). These initial counts are shown in Table 1.

Thermocouples were inserted in the center of three of each lot of 10 patties, and the patties subsequently run through the freezing tunnel. In trials 1, 2 and 3, the patties were frozen with liquid nitrogen spray in a modified Heath freezer tunnel. In trial 4 the patties were frozen with liquid CO₂ in a Certified Multideck freezer. The dwell times in the tunnel were varied to produce equilibrated end-point temperatures that approached predetermined levels.

After freezing, the patties were stacked side by side in an insulated container so that the patties containing the thermocouples were located in the center and approximately equi-

<table>
<thead>
<tr>
<th>Final equilibrated temp (°C)</th>
<th>Trial no.</th>
<th>1</th>
<th>2</th>
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<th>4</th>
</tr>
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<tbody>
<tr>
<td>-47</td>
<td></td>
<td>20-</td>
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<td></td>
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</tr>
<tr>
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<td></td>
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<tr>
<td>-29</td>
<td></td>
<td>0+</td>
<td>0+</td>
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</table>

Table 1—Results of rat feeding trials number showing positive and negative digestion results
DESTRUCTION OF T. spiralis

The patties were frozen to a final equilibrated temperature of -29°C or lower. In trial 3, one positive sample was found at -28°C and positive samples were found at -25°C in both trials 1 and 2. With LCO₂ freezing, there were no positive samples found at the -23°C level. From these results, it was concluded that, if a product attained a final equilibrated temperature of -29°C, it would be rendered free of trichinae and that subsequent freezer holding would be unnecessary.

A processor, therefore, need only assure that temperatures lower than -29°C be attained to render the product free from the danger of trichinae. The USDA (1970) proposed that refrigeration to a temperature of -30°F (-34.4°C) would be accepted as rendering pork and pork products immediately trichina free. The results of this experiment indicate that the treatment prescribed should insure an adequate margin of safety. With modern cryogenic freezing equipment, the attainment of this recommended temperature should be relatively simple and economical and free the processor from the problems associated with the long-term freezer storage of pork to destroy trichinae.

RESULTS & DISCUSSION

The results of the four trials are shown in Table 1. No positive samples were found when the patties were frozen to a final equilibrated temperature of -29°C or lower. In trial 3, one positive sample was found at -28°C and positive samples were found at -25°C in both trials 1 and 2. With LCO₂ freezing, there were no positive samples found at the -23°C level. From these results, it was concluded that, if a product attained a final equilibrated temperature of -29°C, it would be rendered free of trichinae and that subsequent freezer holding would be unnecessary.

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REFERENCES


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