A Research Note

Clostridium botulinum Spores in Infant Foods: A Survey

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ABSTRACT

In an examination of 10 categories of infant foods obtained in the Washington, D.C. area, Clostridium botulinum spores were detected in 2 of 100 samples of honey and 8 of 40 samples of corn syrup. This is the first report of the occurrence of C. botulinum spores in retail samples of corn syrup. In an ensuing nationwide survey of corn syrup, C. botulinum spores were detected in 5 of 961 bottles examined.

Infant botulism was first recognized as a clinical entity in 1976 (11). According to the Centers for Disease Control (personal communication), at least 239 cases had been recorded in the United States as of September 30, 1981. Unlike the usual foodborne botulism which is caused by ingestion of preformed Clostridium botulinum toxin and affects older children and adults, infant botulism is presumed to be caused by ingestion of viable spores, which later grow and produce toxin in susceptible infants under one year of age (1,5). The finding of high numbers of C. botulinum spores in the feces of infants during the acute phase of the disease and the decrease of these numbers as recovery progresses support this presumption. Viable spores may persist in the stools for as long as 176 d (3,10,18). Some human cases involve scarcely discernible manifestations, whereas others require treatment at intensive care facilities (3,5,11). Suckling mice have been infected intragastrically with spores of C. botulinum to provide a laboratory model for the disease (12,13).

Because of the ubiquity of C. botulinum spores in soils of the United States (14), the probability of ingesting foodborne spores is high in this country. Examination of foods, drugs and environmental samples associated with cases of infant botulism showed spores of the corresponding type in garden soil, vacuum cleaner dust and honey (6,7,12). Honey, which was the only food item associated with cases of infant botulism found to contain C. botulinum spores, has been examined extensively. Spores were found in the product throughout the country (9,15). Other items normally fed to infants have not had comparable study; therefore, the Food and Drug Administration (FDA) undertook the present survey to determine whether C. botulinum spores could be found in other foods that constitute the diet of infants under one year of age in the United States.

MATERIALS AND METHODS

Samples

Ten categories of commercially produced infant foods and foods frequently included in infant feeding were examined: infant dry cereals and dry formulas, nonfat dry milk, pasteurized whole cow's milk, canned fruits and fruit juices, honey, corn syrup, granulated cane sugar and fresh carrots. Based on a statistical design for this survey, 90-100 samples of different lots in each category were purchased from grocery stores in the Washington, D.C. metropolitan area and tested for C. botulinum spores.

In addition, samples of corn syrup from a statistically designed nationwide market survey were tested for viable C. botulinum spores. The samples were collected from 64 standard metropolitan statistical areas (17), representing 36 states of the United States. Five retail units of either light or dark corn syrup or a mixture of both were collected from each of 3 retail stores (2 chain and 1 independent grocer) in each metropolitan area. If 5 different brands were not available in a given store, as many different codes as possible were collected of each brand to complete the designated 5. A total of 195 samples was collected; of these, 961 bottles were analyzed by FDA.

Test procedures

Samples containing 25 g of each solid food or 25 ml of each liquid food (except honey and corn syrup) were cultured in 350 ml of tryptose peptone glucose yeast extract broth and incubated at 35°C. Food cultures to which 5-7 spores of C. botulinum were added served as positive controls. After 7 d of incubation, a portion of the supernatant fluid from each culture was tested for C. botulinum toxin and, if positive, typed in mice (8). Fresh carrots, purchased from the produce section of a local grocery store, were cut and boiled until soft in a beaker of water before culturing. Honey and corn syrup were prepared by the method of Sugiyama et al. (16) with the following modifications: (a) dialysis tubing was rinsed once instead of twice, (b) a lower concentration of Clorox® sanitizing solution was used, (c) two mice were inoculated instead of one and (d) culture supernatant fluids were not centrifuged before they were injected into the mice. All portions of samples used for culturing were removed aseptically, weighed or measured and cultured in a vertical laminar flow hood.

RESULTS AND DISCUSSION

The results of the Washington, D.C. area survey are given in Table 1. All samples of cereals, formula, dry
milk, whole milk, canned fruit, canned fruit juice, sugar and carrots were negative for viable spores of \textit{C. botulinum}. Two samples of honey contained viable \textit{C. botulinum} type A spores and 8 samples of corn syrup contained \textit{C. botulinum} type B spores. Because honey had already been investigated extensively (9,12,16), no further survey of this product was undertaken; however, a nationwide survey of corn syrup was made because of the presence of \textit{C. botulinum} spores in corn syrup was previously unknown.

### TABLE 1. Clostridium botulinum spores found in infant foods in the Washington, D.C. area survey.

<table>
<thead>
<tr>
<th>Infant food</th>
<th>Samples tested</th>
<th>Samples positive$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry cereal</td>
<td>90</td>
<td>0</td>
</tr>
<tr>
<td>Commercial baby formula</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Nonfat dry milk</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Fresh whole milk</td>
<td>90</td>
<td>0</td>
</tr>
<tr>
<td>Commercially canned fruits (apricots and tapioca)</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Commercially canned fruit juice (apple-prune juice)</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Honey</td>
<td>100</td>
<td>2 (Type A)</td>
</tr>
<tr>
<td>Corn syrup</td>
<td>40</td>
<td>8 (Type B)</td>
</tr>
<tr>
<td>Sugar</td>
<td>90</td>
<td>0</td>
</tr>
<tr>
<td>Fresh cooked carrots</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

$^a$Spore type found is indicated in parentheses.

Corn syrup was collected nationwide from chain supermarkets and independent grocery stores in an attempt to obtain samples from all manufacturers. Of 961 bottles of corn syrup analyzed in the nationwide survey, 5 contained viable spores of \textit{C. botulinum} type B in a concentration estimated by the 5-tube most probable number method of Sugiyama et al. (16) to be 1.25 spores/25 g. Although this level of contamination is very low, it nevertheless constitutes evidence that corn syrup may be another possible vehicle for infant botulism.

A previous study which attempted to correlate cases of infant botulism with the finding of spores in infants' food (12) showed that 8 of the infants had been fed corn syrup; however, no \textit{C. botulinum} spores were found in the syrup.

The presence of \textit{C. botulinum} in foods other than low-acid canned foods does not violate food processing regulations. \textit{C. botulinum} is found in the soil and on raw soil-grown foods. Because many food processes do not include steps that are lethal to \textit{C. botulinum}, the organism (but not its toxins) would be expected to be found occasionally in finished foods. The reason for the susceptibility of some infants to botulism, however, is unknown; therefore, FDA advises avoidance of such foods as honey and corn syrup for feeding infants since they are not essential in infant feeding (2).

### REFERENCES