Enterotoxigenic Escherichia coli Isolated from Foods in São Paulo, Brazil

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ABSTRACT

Incidence of enterotoxigenic Escherichia coli (ETEC) in foods usually consumed in the city of São Paulo, Brazil was determined. Raw and cooked foods of animal and vegetable origin were investigated. Enterotoxigenic strains were found in approximately 3.5% of food samples contaminated with E. coli. There was a great predominance of ETEC strains producing only LT enterotoxin. None of the isolated strains produced LT and ST simultaneously. Several serotypes were involved, and none of them was positive for colonization factors CFA-I and CFA-II. One ETEC showed resistance to some antibiotics but most were sensitive to the ones tested.

Enterotoxigenic Escherichia coli (ETEC) is an etiological agent of gastroenteritis in humans and animals. ETEC produces two types of enterotoxins: heat stable (ST) and heat labile (LT). Once in the intestinal tract, these pathogens adhere to and colonize the epithelial cell surfaces of the small intestine. Then, the toxins produced by ETEC stimulate fluid secretion to the lumen of the gut (12).

These enteropathogens have been described in developed nations as well as in countries with poor sanitation. In Brazil, the frequency of diarrhea caused by enterotoxigenic E. coli seems to be similar to that of Salmonella or Shigella. Several outbreaks of gastroenteritis in different parts of the world were associated with the consumption of foods and water contaminated with enterotoxigenic E. coli (2,11,18,22,23). In our country, some studies were already carried out concerning the incidence of ETEC in raw foods of animal origin (17) and in water (21), showing the predominance of LT-producing strains. Our study refers to the incidence of ETEC in a great variety of raw and cooked foods, of animal and vegetable origin, currently consumed in the metropolitan area of São Paulo, Brazil, and describes some properties of the isolated pathogenic strains.

MATERIALS AND METHODS

Food samples and E. coli strains

A large number of food samples was examined and 287 contaminated with E. coli were selected. Approximately half of the samples examined were purchased directly from food stores in the city of São Paulo, and the remainder were provided by an Official Government Analysis Laboratory (Instituto Adolfo Lutz). One hundred and fifty-one E. coli strains were isolated, using the method adopted by Sack et al. (20) or by methods currently used for isolation of fecal coliforms in foods (12). Biochemical identification of E. coli was done according to Edwards and Ewing (5). Foods of animal origin that harbored E. coli were raw and cooked beef, pork, chicken and fish, pasteurized milk and cheese. Foods of vegetable origin were: raw and cooked vegetables, fruit juices and spices. Mixed foods and ready-to-eat meals, having animal and vegetable components, were also studied.

Detection of ST and LT enterotoxins

Production of ST enterotoxin was tested using the suckling mouse assay (3), and production of LT enterotoxin was detected by biologic activity in Y-1 adrenal cells (19).

Detection of colonization factors CFA-I and CFA-II

The ETEC strains isolated from food were studied for presence of colonization factors CFA-I and CFA-II using the hemagglutination test of human and bovine erythrocytes (6,7).

Detection of antibiotic resistance patterns

The ETEC strains isolated from food were studied for resistance to the following antibiotics: amikacin (30 μg), ampicillin (10 μg), carbencillin (100 μg), cephalothin (30 μg), chloramphenicol (30 μg), streptomycin (10 μg), gentamycin (10 μg), kanamycin (30 μg), nitrofurantoin (30 μg), polymyxin B (300
TABLE 1. Frequency of recovery of enterotoxigenic Escherichia coli (ETEC) in foods in São Paulo, Brazil.

<table>
<thead>
<tr>
<th>Samples</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food samples positive for E. coli</td>
<td>287</td>
</tr>
<tr>
<td>Food samples positive for ETEC</td>
<td>10 (3.5%)</td>
</tr>
<tr>
<td>E. coli isolates obtained</td>
<td>1351</td>
</tr>
<tr>
<td>ETEC isolates obtained</td>
<td>17 (1.3%)</td>
</tr>
<tr>
<td>ETEC isolates that produced LT only</td>
<td>13 (76.5%)</td>
</tr>
<tr>
<td>ETEC isolates that produced ST only</td>
<td>4 (23.5%)</td>
</tr>
<tr>
<td>ETEC isolates that produced both ST and LT</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

U), sulfatrim (25 µg), sulfonamid (300 µg), tetracycline (30 µg) and tobramycin (10 µg). The method proposed by Bauer et al. (1) was used in this determination.

RESULTS AND DISCUSSION

The frequency of recovery of toxigenic strains in the foods tested is shown in Table 1. The source of the strains, their enterotoxigenic phenotype, serotype and susceptibility to antibiotics are shown in Table 2.

Our data indicate that the frequency of occurrence of ETEC in foods contaminated with E. coli is low (nearly 3.5%). Isolation was more frequent from foods of animal origin. Studies done worldwide on the frequency of these pathogens in foods show that their incidence is variable, depending on the geographical location and the specific type of food analyzed. Isolation of enterotoxigenic strains among E. coli recovered from foods also seems to be variable. Sack et al. (20) stated that production of enterotoxin is relatively common among E. coli strains isolated from foods of animal origin, in the USA. In contrast, less than 1% of E. coli isolated from foods and water from an Ethiopian community were enterotoxigenic (2). Echeverria (4) failed to recover ETEC from 150 food and water samples in a town in the Philippines. In Brazil, Reis et al. (17) detected only 1.5% of ETEC strains among E. coli isolated from processed raw food of animal origin. These authors recovered ETEC in 5 to 10% of food samples, depending on the type of food analyzed. The frequency of occurrence of ETEC in foods detected in our study is very similar to that reported by Reis et al. (17).

The great prevalence of ETEC that produced only LT enterotoxin agrees with previous results in Brazilian foods (17) and water and sewage (21). The epidemiological significance of these results is not clear, since ETEC that produce only LT had been found in higher frequency in controls than in humans with diarrhea, in Brazil (16). Foodborne gastroenteritis caused by ETEC has not been described in Brazil yet, but they have already occurred in other countries, some of them caused by ETEC that produce only LT (2,11,23).

The serotypes of the enterotoxigenic strains do not correspond to those more frequently associated with diarrhea (13,14,15,16). The reason for this is the fact that strains isolated from foods produce only LT, which usually belong to a great variety of serotypes (10,16). The fact that both LT and ST are plasmid-borne, and probably are on transposons, may explain our observation (8). Among strains that produced only ST, we detected serogroup 0149, which had already been detected in Brazilian foods before, but associated with other H antigens (17). The failure to detect colonization factors CFA-I and CFA-II is also explained by the fact that strains produce only LT. The mentioned colonization factors are more common in strains that produce both enterotoxins (10).

Most toxigenic strains isolated from foods were sensitive to the antibiotics tested, except for one resistant strain isolated from pasteurized milk. Our results confirm previous findings in Brazilian foods and water (17,21). Detection of antibiotic resistant strains in foods may be a consequence of excessive use of antibiotics in human and animal therapy.

Certainly, the actual frequency of ETEC in foods is higher than the one detected here as well as the ones detected by other authors (4,9,17,20,21). It’s well known that some of these pathogens exhibit poor growth at high temperatures normally employed in their isolation from foods (12).

Good hygienic practices during manufacturing of foods are essential to reduce the frequency of these pathogens,
and to assure their safety for human and animal consumption.

REFERENCES


