

Infections Associated With Powdered Infant Formula

Benjamin Estrada, MD

Infect Med. 2002;19(8)

Introduction

Powdered infant formula products are not sterile and may be colonized with bacterial organisms. During the last 20 years, there have been multiple reports associating bacterial colonization of dried formula with infection among infants who have been fed with these products. *Salmonella* species and other members of the family Enterobacteriaceae have been identified in most of these events.

Salmonellosis caused by ingestion of contaminated powdered infant formula has been reported in the United States and other countries. In 1993, infection caused by *Salmonella* serotype Tennessee among infants in Canada and the United States was linked to the ingestion of a powdered milk product, which was recalled after cases were identified (Centers for Disease Control and Prevention. *MMWR*. 1993;42:516-517). Similarly, during 1994 in Spain, 48 cases of salmonellosis among infants younger than 12 months were linked to ingestion of formula contaminated with *Salmonella virchow* (Usera MA et al. *Eur J Clin Microbiol Infect Dis*. 1998;17:551-553).

In addition to *Salmonella* species, other Enterobacteriaceae are known to be able to colonize powdered infant formula. In a study performed by Muytjens and collaborators (Muytjens HL et al. *J Clin Microbiol*. 1998;26:743-746), 141 powdered human milk substitutes obtained from 35 different countries were analyzed for the presence of Enterobacteriaceae. These investigators were able to isolate bacterial organisms from 52.5% of the products evaluated. The species most frequently isolated included *Enterobacter agglomerans*, *Enterobacter cloacae*, *Enterobacter sakazakii*, and *Klebsiella pneumoniae*. However, none of the formulas tested in this study had bacterial concentrations higher than 3 colony-forming units/g; therefore these formulas met the requirement for bacterial count of coliform organisms in infant formulas recommended by the Food and Agricultural Organization of the United Nations.

Contamination of dried milk products with *E sakazakii* frequently has been associated with development of disease among infants. The spectrum of infection caused by these organisms includes septicemia, meningitis, and urinary tract infection (Simmons BP et al. *Infect Control Hosp Epidemiol*. 1989;10:398-401; Bar-Oz B et al. *Acta Paediatr*. 2001;90:356-358). In addition, a significant association between infant formula colonization with *E sakazakii* and the development of necrotizing enterocolitis was recently reported among infants in a neonatal ICU in Belgium (van Acker J et al. *J Clin Microbiol*. 2001;39:293-297). It has been suggested that increased resistance to heat by *E sakazakii* may play a role in its ability to colonize dried milk.

The CDC recently reported an outbreak of *E sakazakii* infections associated with the use of infant formula in Tennessee. During this outbreak, a total of 10 colonization or infection events were identified among 49 screened infants. The organism was identified among samples of powdered formula used in the neonatal ICU where this outbreak was reported. In addition, pulsed-field electrophoresis revealed that isolates of *E sakazakii* from the cerebrospinal fluid of a neonate with meningitis and isolates from the cultures of powdered formula were similar. The manufacturer recalled the batch of formula implicated in this outbreak. The CDC has asked health care providers to report cases of invasive disease caused by *E sakazakii* among infants younger than 12 months (Centers for Disease Control and Prevention. *MMWR*. 2002;51:298-300).

Practitioners should be aware of the possibility of bacterial contamination of powdered infant formulas. To decrease the risk of contamination, powdered formula should be prepared and stored in accordance with guidelines issued by the American Dietetic Association and the FDA (Centers for Disease Control and Prevention. *MMWR*. 2002;51:298-300).

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