Safety Aspects in Preparation and Handling of Infant Food

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Key Words

Breastfeeding • Infant formula • Infant food • Preparation • Handling • *Cronobacter* spp. • *Enterobacter sakazakii*

Abstract

Powdered infant formula (PIF) can become contaminated during production with harmful bacteria such as *Cronobacter* spp. (formerly *Enterobacter sakazakii*). Inadequate conditions of preparation and handling of PIF can therefore exacerbate the risk of severe infection, especially in preterm infants. The WHO emphasized three main interventions for preparation and handling of PIF: (1) to dilute the powdered milk in water at a temperature of at least 70°C to inactivate *Cronobacter* spp.; (2) to consume milk right after each preparation, and (3) to store reconstituted milk at <5°C. The European Society for Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) and the French Food Safety Agency (Afssa) disagree with the heating process because of possible adverse effects on nutrients and the risk of severe burns. In home settings, PIF should be prepared fresh for each meal and be kept warm in bottle warmers or thermos bottles. In institutional settings, written guidelines for preparation and handling of PIF should be established. The use of sterile liquid formula is encouraged for healthy newborn

infants in maternity wards; PIF should be prepared on a daily basis. Safe infant feeding involves the production of microbiologically cleaner infant formula by industry, and both education and support for the caregivers in preparing and handling the formula.

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Introduction

Infants are at a higher risk to develop foodborne disease because their immune system is still undergoing maturation and the protection against invasive infections afforded by their intestinal microbiota is not as effective as in adults.

Breast Milk and Infant Formula

Breast milk is the natural food for infants. It contains numerous immune-related components that offer passive protection in the gastrointestinal tract and to some extent in the upper respiratory tract, thereby protecting the breastfed infant against invasive infections [1]. In 2001, the WHO emphasized exclusive breast feeding for 6

months and continued breastfeeding up to 2 years of age or beyond [2].

Non-breastfed infants should be fed infant formula (IF), the composition of which complies with the standards defined in the Directive 2006/141/EC of 22 December 2006 on IF and follow-on formulae and in the Directive 1999/21/EC on dietary foods for special medical purposes [3, 4]. These two directives stress that 'infant and follow-on formulae shall not contain any substance in such quantity as to endanger the health of infants and young children'.

Risks Related to the Use of IF

In Europe, IF are available in 2 types: ready-to-feed liquid and powdered. Powdered IF (PIF) can become contaminated during production with harmful bacteria, even in very small amounts, such as *Cronobacter* spp. (formerly *Enterobacter sakazakii*) [5]. This is because using current technology, manufacturing processes cannot achieve the production of sterile PIF [6]. An international survey showed the presence of *Cronobacter* spp. in 1% of tested follow-on formula and in 12% of infant foods and drinks [7]. The Codex alimentarius (a United Nations body tasked by FAO and WHO determining international standards for food production and safety) has published specifications for *Salmonella*. Specific criteria for *Cronobacter* spp. are not included, but come under the general category of coliforms [5].

Reconstituted PIF are excellent media for multiplication of potentially pathogenic bacteria. Inadequate conditions of preparation and handling of PIF can therefore exacerbate the risk of severe infection. In a study performed in the USA, IF prepared at bedside were 24 times more likely to show contamination than those prepared in a central location, and PIF were 14 times more likely to be contaminated than ready-to-feed formulae [8]. Spanish investigators reported that contaminated feeding bottles were the source of an outbreak of *Pseudomonas aeruginosa* infection in a neonatal intensive care unit [9]. *Cronobacter* spp. can also be found in food and beverages other than IF and milk powder [10].

Since 1958, there have been approximately 120 reported cases of *Cronobacter* spp. infection in infants and children <3 years of age. Outbreaks were observed in Belgium in 1998 and in New Zealand and France in 2004. The population at greatest risk for *Cronobacter* spp. infection includes preterm infants born before 36 weeks of gestational age up to a post-term age of 4–6 weeks, term in-

fants hospitalized in level 2 and 3 neonatal intensive care units, and immunocompromized infants at any age. Infections have been observed not only in hospitals but also in outpatient settings [11]. Six PIF-associated *Salmonella* outbreaks have been described since 1995 across Canada, France, Korea, Spain, UK, and USA. The most recent was an outbreak of *Salmonella agona* that occurred in France in 2005, involving 141 infants <1 year of age.

The effect of temperature on the growth of *Cronobacter* spp. is striking. Minimal and maximal growth temperature are 5.5–8°C and 47°C, respectively. Therefore, at room temperature, there is a potential for rapid growth of *Cronobacter* spp. [5].

Recommendations of Official Bodies

Breast Milk

After collection, any break in the cold chain must be avoided. There are two storage options: (1) storage in the refrigerator: the milk may be stored at a temperature not exceeding 4°C for not more than 48 h; (2) storage in the freezer: milk stored in the freezer (–18°C) can be stored for 4 months with no detrimental effects [12].

Infant Formula

The WHO introduced the Five Keys to Safer Food poster in 2001. It consists of simple headings that are more easily remembered, specific suggestions for improvement, and reasons behind the suggested measures. Copies are available at: <http://www.who.int/foodsafety/publications/consumer/5keys/en/index.html>. The WHO has also published the Five Keys to Safer Food Manual. Copies are available at: <http://www.who.int/foodsafety/consumer/5keysmanual/en>. The components of the Five Keys to Safer Foods are: (1) keep clean; (2) separate raw and cooked; (3) cook food thoroughly; (4) keep food at safe temperature, and (5) use safe water and raw materials.

The WHO suggested three main interventions for preparation and handling of IF: (1) to dilute the powdered milk in water at a temperature of at least 70°C to inactivate *Cronobacter* spp.; (2) to consume milk right after each preparation, and (3) to store reconstituted milk at <5°C [13]. Similar recommendations have been put forward by the UK Department of Health, the Finnish Food Safety Authority, Health Canada [14], and the European Food Safety Authority [15]. However, the untoward consequences of the use of hot water can lead to the formation of curds, the risk of burns for households (especially

children), and the loss of 10–25% of some nutrients, mainly vitamins (thiamine, vitamins B1, B6 and B12, folic acid, and vitamin C) [12]. The Committee on Nutrition of the European Society for Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN CoN) [11] and the French Food Safety Agency (Afssa) [12] disagree with the use of boiling water and of heating of reconstituted formula to temperatures close to the boiling point because of possible adverse effects on nutrients and the risk of severe burns.

ESPGHAN CoN recommended that, in home settings, PIF should be prepared fresh for each meal and that IF should never be kept warm in bottle warmers or thermos bottles [11]. In institutional settings, written guidelines for preparation and handling of IF should be established, and their implementation should be monitored; the use of sterile liquid formula is encouraged for healthy newborn infants in maternity wards; if formula needs to be prepared in advance, it should be prepared on a daily basis and kept at 4°C or below for not more than 30 h. The storage temperature should be monitored [11, 16]. Studies comparing WHO/EFSa and ESPGHAN/Afssa recommendations are urgently needed.

Knowledge of Parents and Caregivers

Information of parents is also a critical issue. In a recent US survey, the majority of IF-feeding mothers did not receive instruction on formula preparation (77%) or

storage (73%) from a health professional [17]. Among the mothers of the youngest infants, 55% did not always wash their hands with soap before preparing IF, 32% did not adequately wash bottle nipples between uses, and 35% heated formula bottles in a microwave oven. The conclusion of a recent systematic review of studies on mothers' experiences of bottle feeding was that inadequate information and support for mothers who decide to bottle feed may put the health of their babies at risk. While it is important to promote breastfeeding, it is also necessary to ensure that the needs of bottle-feeding mothers are met [18]. This issue is also underlined in the Baby Friendly Initiative [19].

Conclusion

Safe infant feeding involves the production of microbiologically cleaner IF by industry, and both education and support for the caregivers in preparing and handling the formula.

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