



World Health  
Organization



## International Food Safety Authorities Network (INFOSAN)

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INFOSAN Information Note No. 3/2008 - Food Safety and Nutrition During Pregnancy and Infant Feeding

### Food Safety and Nutrition During Pregnancy and Infant Feeding

#### SUMMARY NOTES

- Pregnant women, the developing fetus, infants and young children are especially susceptible to certain chemical and microbiological hazards and need special protection.
- As the nutritional requirements of pregnant and lactating mothers and infants are different to those of the general population, tailored nutritional information should be provided to pregnant mothers and caregivers.
- Food safety authorities have a responsibility to work with nutritionists and maternal and child health professionals involved in pregnancy and infant feeding to ensure pregnant mothers and caregivers are provided with food safety and nutrition advice that can help to prevent foodborne disease and improve their nutritional status.
- Many good examples of risk communication provided by food safety and public health authorities exist to assist with this.
- Information provided to consumers should reflect the local situation and hazards of most concern to the country or region, including the need in some cases to balance health risks and nutritional benefits.

While all population groups are susceptible to foodborne disease, there are groups more susceptible to foodborne disease due to their low-levels of immunity, early stages of development or greater exposure. This note focuses on two high-risk groups; pregnant women and infants<sup>1</sup>. This also includes the developing fetus as well as young children:

**Pregnant women:** Hormonal changes during pregnancy affect the mother's immune system resulting in decreased immune function and greater susceptibility to foodborne disease. Also the developing fetus is susceptible to foodborne pathogens that may not cause symptoms of illness in pregnant women.

**Infants (children less than 1 year old):** Because their immature immune systems and developing organs, particularly kidney and brain, infants and young children are more prone to foodborne disease. In addition, infants and young children consume more food in proportion to their body weight than adults; hence they have greater relative exposure to foodborne toxins and contaminants.

It is critical to control, to the greatest extent, possible food safety hazards during pregnancy and lactation as well as during initial complementary feeding of infants. Food safety controls during these periods should be integrated with nutritional guidance. For example, to prevent exposure to certain chemicals and pathogens, avoidance of specific foods is often recommended. However the nutritional impact should also be considered when providing such advice. Therefore, to help ensure pregnant mothers and caregivers make an informed decision on food safety and dietary issues, it is important that both food safety and nutritional advice be incorporated into guidance for pregnant mothers and caregivers. Specific issues for pregnant mothers and caregivers along with general information on food safety<sup>2</sup> and nutrition applicable to all life stages should be included in this advice. This note outlines examples of specific issues that may be considered in such advice.

<sup>1</sup> Other high-risk groups are discussed in INFOSAN Information Note No. 5/2006 - Five Keys to Safer Food  
[http://www.who.int/foodsafety/fs\\_management/No\\_05\\_5keys\\_Oct06\\_en.pdf](http://www.who.int/foodsafety/fs_management/No_05_5keys_Oct06_en.pdf)

<sup>2</sup> WHO's Five Keys to Safer Food is an example of general food safety messages - see <http://www.who.int/foodsafety/consumer/5keys/en>

## **Food safety during pregnancy, lactation and infancy**

Foodborne disease during pregnancy can cause serious health problems to the mother, fetus or both. These include miscarriage, premature birth, stillbirth, death of the mother or neonatal illness. Different microbial and chemical contaminants can affect the mother and fetus or neonate in a variety of ways. Sometimes foodborne disease can make the mother sick, while in other cases the symptoms are absent or so mild that the mother is unaware of infection or exposure to a hazard, but still passing the infection or hazard to her unborn child who may then experience serious effects from the illness.

### **Chemical contamination of food**

A number of chemical contaminants of synthetic and natural origins can be harmful to both the fetus and infant. For example, some pesticides, heavy metals and other toxins can cross the placenta resulting in exposure of the fetus. These chemicals can also be excreted in the mothers' milk.

### **Heavy metals (lead and mercury)**

Although chemical hazards of concern for pregnant mothers and infants vary from country to country because of local situations, lead and mercury exposure are of concern in many regions because of their effects on the developing nervous system. Therefore the fetus, infants and young children are particularly susceptible. Exposure to lead and mercury by the fetus and in the young through maternal blood, breast milk and food, may result in neurotoxic effects such as reduced intelligence and behavioural problems.

Food safety control measures to reduce exposure to lead:

- Washing fruit and vegetables thoroughly
- Avoiding the use of colourful ceramic containers, particularly with acidic foods.
- Avoiding food in cans with lead-soldered seams.
- Avoiding food produced or prepared near busy roads in countries that use lead in petrol or near smelters or lead-contaminated areas
- Control lead at source, e.g. through the use of un-leaded petrol

Food is the main source of exposure to mercury, mostly in the form of methylmercury. This exposure occurs mainly via fish consumption, particularly the long-lived, large, predatory fish at the top of the food-chain, where biomagnification occurs (e.g. shark, swordfish and marlin). However, fish also contain beneficial protein, unsaturated fatty acids and important micronutrients for both the mother and the developing fetus. In general, food safety messages should therefore encourage women to switch their consumption from high-mercury fish to low-mercury fish. The actual message adopted needs to be specific for the country/region and situation as the importance of various types of fish in the diet needs to be considered. When providing messages, it is important that the health benefits of fish are explained, to ensure an important nutrient source is not excluded from the diet. In addition, such messages should be based upon knowledge of the locally predominant fish species and their levels of mercury.

### **Dioxins and persistent organic pollutants**

Dioxins and other persistent organic pollutants (POPs)<sup>3</sup> are industrial products and by-products that bioaccumulate in the environment and the food chain mainly in foods of animal origin, such as fish, meat, eggs and dairy products. POPs can cross the placenta and can be found in breast milk. High-level exposures in utero and postnatally to certain POPs have been connected to neurological, respiratory, reproductive and developmental changes. Consumption of low-fat animal products and removing fat from meat will lead to a lower level of exposure, particularly for girls and young women. Most important measures to reduce exposure to POPs is via source-directed measures, e.g. emission control, proper waste-management, but these are long-term solutions. Systematic monitoring is important to avoid highly-contaminated foods entering the food supply.

### **Mycotoxins**

In some parts of the world, infants may be exposed to mycotoxins (such as aflatoxins) generated in mouldy maize, peanuts or other grains ingested by the lactating mother or fed as complementary food to young children. Aflatoxins may generate severe disease in the child, impair growth and contribute (by

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<sup>3</sup> POPs are discussed in INFOSAN Information Note No. 2/2007- Biomonitoring of Persistent Organic Pollutants (POPs) - [http://www.who.int/foodsafety/fs\\_management/No\\_02\\_POPs\\_Apr07\\_en.pdf](http://www.who.int/foodsafety/fs_management/No_02_POPs_Apr07_en.pdf)

possibly interacting with hepatitis B virus) to hepatocellular carcinoma. A series of interventions are available, such as food monitoring programmes in high-risk areas and instructions on the preparation of food using non-mouldy grains, as well as hepatitis A vaccination programmes.

Although exposure to lead, mercury and POPs can occur via breast milk, the benefits of breastfeeding almost always outweighs the potential risks and WHO recommends exclusive breastfeeding for the first six months.

## **Microbiological contamination of food**

### ***Listeria monocytogenes*<sup>4</sup>**

Foodborne listeriosis, caused by the bacterium *L. monocytogenes* is a relatively rare (0.1 to 10 cases per million inhabitants per year), but serious disease with very high fatality rates of 20-30%. While listeriosis occur in adults it is especially important in the fetus, and around 40% of all cases are pregnancy-related, where the disease can cause miscarriage, premature birth, stillbirth and neonatal disease.

Food is the principle route of transmission for listeriosis. Raw foods may be contaminated by microbes in the environment (through soil or manure) or by asymptomatic animals that are used for food. In addition, cooked foods may be re-contaminated after processing. *L. monocytogenes* is particularly dangerous as it has the ability to grow at refrigerator temperatures. High risk foods includes deli meat and ready-to-eat meat products (e.g. cooked, cured and/or fermented meats and sausages), soft cheeses and cold smoked fishery products.

Food safety control for preventing *L. monocytogenes* in pregnant women include:

- Avoiding high risk foods, which are not cooked prior to eating. For example, smoked and lightly preserved fish or seafood, unpasteurized milk and its products (e.g. soft cheeses), pâté, and prepared salads from stores.
- Cooking meats, including both raw, processed (e.g. ham, hot dogs and cold meats) and leftovers thoroughly.
- Avoiding perishable foods that are past their 'consume before' dates.

Additional to public education campaigns, food safety authorities should mandate control measures in food businesses handling *Listeria*-prone foods. In foods that permit growth, the inclusion of control measures, such as temperature control or limiting storage periods, will mitigate the risk. Processed foods identified as being contaminated with *L. monocytogenes* should be considered for possible recall. However, the final decision will be based on an assessment considering national policy and regulations, the number of pathogens found in the food, the possibility for growth in the food, the presence of 'consume before' dates and the shelf-life of the product.

### ***Toxoplasma gondii*<sup>5,6,7</sup>**

Caused by the protozoan parasite *T. gondii*, toxoplasmosis is a highly prevalent disease worldwide with serious long-term implications for the fetus. While it is estimated that 25% of the general population carries the *Toxoplasma* parasite, toxoplasmosis in a healthy person usually causes only mild flu-like symptoms. However, congenital toxoplasmosis, which occurs when a woman becomes infected during or shortly before pregnancy, can lead to serious fetal damage, such as mental retardation, blindness, cerebral palsy, stillbirth and spontaneous abortion. In countries with the highest incidence, up to 3 to 6 per 1000 babies are born with toxoplasmosis each year

The host of *T. gondii* is the cat family *Felidae*, in which the parasite undergoes sexual reproduction and is shed as oocysts in the faeces. Human infection can follow several different routes, including:

- Consuming uncooked or undercooked meat containing cysts of *Toxoplasma*
- Consuming food or water contaminated with soil or cat faeces containing oocysts
- Contact with infected domestic and feral cats

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<sup>4</sup> FAO, WHO. Risk assessment of *Listeria monocytogenes* in ready-to-eat foods. Microbiological Risk Assessment Series, No 5 (2004). [http://www.fao.org/ag/aqn/agns/jemra\\_riskassessment\\_listeria\\_en.asp](http://www.fao.org/ag/aqn/agns/jemra_riskassessment_listeria_en.asp) [http://www.who.int/foodsafety/publications/micro/mra\\_listeria/en/index.html](http://www.who.int/foodsafety/publications/micro/mra_listeria/en/index.html)

<sup>5</sup> Cook AJC et al. on behalf of the European Research Network on Congenital Toxoplasmosis (2000). *BMJ*, 321:142-147.

<sup>6</sup> Hughes JM et al. (2000). Preventing Congenital Toxoplasmosis *Morbidity and Mortality Weekly Report* 49(RR02), 57-75.

<sup>7</sup> Jones JL, Kruszon-Moran D, Wilson M (2003). *Toxoplasma gondii* Infection in the United States, 1999-2000. *Emerging Infectious Diseases*, 9, 1371-1374.

Food safety control measures preventing *T. gondii* infections in pregnant women include:

- Avoiding meat and meat products that have not been treated to eliminate the parasite. Treatment may be cooking, freezing or irradiation
- Washing vegetables and other foods that may come into contact with soil or cat faeces
- Washing hands, surfaces, and cooking implements after coming in contact with cats, raw meats and soil.
- Preventing cats from surfaces where food is prepared, e.g. keeping cats out of the kitchen.
- Avoiding unpasteurized milk and dairy products.

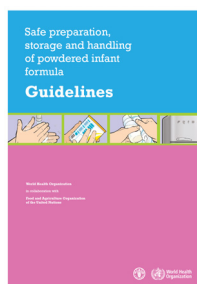
### ***Enterobacter sakazakii*<sup>8</sup> and *Salmonella* in powdered infant formula<sup>9</sup>**

Powdered infant formula (PIF) has been associated with serious illness and death in infants due to infections with bacteria: *E. sakazakii* and *Salmonella*. *E. sakazakii* can cause illness in all ages groups, with neonates (first 28 days) and infants under two months at greatest risk. Pre-term infants and low-birth-weight (less than 2.5kg) infants or immunocompromised infants are at greatest risk. The illness causes sepsis, meningitis or necrotising enterocolitis. Salmonellosis causes headache, abdominal pain, diarrhoea, nausea and sometimes vomiting. Additionally, dehydration is a concern for infants who are more likely to experience severe illness or death than other age groups. Infants with immunocompromising conditions are particular vulnerable.

While liquid infant formula can be sterile, with current manufacturing technology, it is not feasible to produce sterile PIF and pathogens such as *E. sakazakii* and *Salmonella enterica* may be present in the powder. During the preparation of PIF, inappropriate handling practices can exacerbate the problem. Although *E. sakazakii* and *Salmonella* do not grow in the powder, *E. sakazakii* can survive up to and beyond 1 year in dry PIF. However, once reconstituted there is the potential for these microorganisms to grow depending on the conditions of preparation, storage (especially temperature) and use.

Food safety control measures preventing foodborne disease from PIF:

- In general, using sterile liquid infant formula for infants at the highest risk of infection.
- Where sterile liquid infant formula is not available, preparing PIF with water at a temperature of no less than 70°C. This will greatly reduce *E. sakazakii* and *Salmonella* present in the powder.
- Minimizing the time from preparation to consumption (maximum of two hours).
- Storing prepared feed at temperatures no higher than 5 °C.
- Using clean and sterilized feeding and preparation equipment.
- Informing users of PIF, through public education and labelling, that powdered infant formula is not a sterile product and may be contaminated with pathogens that can cause serious illness.



These controls measures are explained in the 'Safe preparation, storage and handling of powdered infant formula guidelines' (WHO in collaboration with FAO, 2007) available at: <http://www.who.int/foodsafety/publications/micro/pif2007/en> and [http://www.fao.org/ag/agn/agns/jemra\\_riskassessment\\_enterobacter\\_docs\\_en.asp](http://www.fao.org/ag/agn/agns/jemra_riskassessment_enterobacter_docs_en.asp)

FAO and WHO are supporting the dissemination and implementation of these guidelines at a national level. Interested national authorities should e-mail [foodsafety@who.int](mailto:foodsafety@who.int) for further information.

FAO and WHO have also developed an on-line interactive model (available at [www.mramodels.org](http://www.mramodels.org)) to help countries evaluate alternative control measures for their country.

Food safety authorities should also work with PIF manufacturers to encourage their on-going research into technological improvements towards the reduction of PIF contamination during processing.

<sup>8</sup> For further information on *Enterobacter sakazakii* see the INFOSAN Information Note 1/2005 formation Note - *Enterobacter sakazakii* in powdered infant formula [http://www.who.int/foodsafety/fs\\_management/No\\_02\\_Avianinfluenza\\_Dec04\\_en.pdf](http://www.who.int/foodsafety/fs_management/No_02_Avianinfluenza_Dec04_en.pdf)

<sup>9</sup> FAO, WHO. *Enterobacter sakazakii* and *Salmonella* in powdered infant formula. Microbiological Risk Assessment Series, No 10 (2006). [http://www.fao.org/ag/agn/agns/jemra\\_riskassessment\\_enterobacter\\_en.asp](http://www.fao.org/ag/agn/agns/jemra_riskassessment_enterobacter_en.asp) or <http://www.who.int/foodsafety/publications/micro/mra10/en>

## **Food safety in the context of the nutritional requirements of infants and young children**

### **Infants less than 6 months old**

In general, infants should receive only breast milk during the first six months of life, with no additional food or liquids, not even water. Thereafter, to meet their evolving nutritional requirements, infants should receive nutritionally adequate and safe complementary foods while breastfeeding continues for up to two years of age or beyond. It is important to support breastfeeding and promote its benefits for infants and young children.<sup>10</sup>

A small number of health conditions of the infant or the mother may justify recommending her not to breastfeed, or to introduce supplements in the first six months of life e.g. a metabolic condition such as classic galactosemia, or a maternal condition that requires cytotoxic chemotherapy<sup>11</sup>. There are instances where breast milk is not available, where the mother is unable to breastfeed, or where they have made an informed decision not to breastfeed, e.g. where the mother is taking medication that is contraindicated for breastfeeding. Similarly, some very low-birth-weight babies may not be able to breastfeed directly, and in some cases expressed breast milk may not be available or available in insufficient quantities.

Infants who are not breastfed require a suitable breast-milk substitute, that is, an infant formula prepared in accordance with the guidelines (discussed above) or equivalent guidelines provided by national authorities. Food safety agencies, with nutritionists, have an important role to work with manufacturers to ensure that the International Code of Marketing of Breast-milk Substitutes<sup>12</sup> is adhered to.

### **Breastfeeding and HIV/AIDS<sup>13</sup>**

HIV can be transmitted from an infected mother to her baby during pregnancy, delivery and through breast milk. Avoidance of all breastfeeding by HIV-infected women is recommended when replacement feeding is acceptable, feasible, affordable, sustainable and safe. Where meeting all five of these requirements is not possible, exclusive breastfeeding is recommended for the first 6 months of life. At or after 6 months, all breastfeeding should stop once a nutritionally adequate and safe diet can be provided.

Whatever the feeding decision, health services should follow-up all HIV-exposed infants, and continue to offer infant feeding counselling and support, particularly when feeding decisions may be reconsidered, such as the time of early infant diagnosis<sup>14</sup>. Feeding options for HIV-positive women involve certain food safety aspects and such advice can benefit from the input from food safety authorities.

Examples include:

- Preparation of infant formula according to hygienic practices (discussed below);
- The importance of hygienic practices when handling and storing expressed breast milk; and
- Heat-treating (pasteurization or boiling) breast milk to destroy HIV and subsequent controls with regard to cooling and storage (undertaken by individuals and milk banks) to prevent microbial growth.

### **Feeding of infants and young children 6 to 12 months old (Note that this information also applies to children in their second year of life).<sup>15,16,17</sup>**

Caregivers should practice responsive feeding: feeding infants directly, slowly and patiently, being sensitive to hunger and satiety cues. They should gradually increase food amounts, consistency and variety as the infant gets older, adapting to the infant's requirements and abilities. They should use fortified complementary foods or vitamin-mineral supplements as required. They should increase fluid intake during illness, including more frequent breastfeeding.

Attention to hygienic practices during food preparation and feeding is critical for prevention of gastrointestinal illness. The peak incidence of diarrhoeal disease is during the second half year of infancy

<sup>10</sup> WHO/UNICEF. Global Strategy for Infant and Young Child Feeding. World Health Organization, Geneva. 2003.

<sup>11</sup> WHO. Acceptable Medical Reasons for use of breast-milk substitutes. World Health Organization, Geneva. 2008 (draft)

<sup>12</sup> The International Code of Marketing of Breast-milk Substitutes is available at: [http://www.who.int/nutrition/publications/code\\_english.pdf](http://www.who.int/nutrition/publications/code_english.pdf)

<sup>13</sup> WHO.(2004) HIV transmission through breastfeeding: a review of available evidence [http://www.who.int/child-adolescent-health/New\\_Publications/NUTRITION/ISBN\\_92\\_4\\_156271\\_4.pdf](http://www.who.int/child-adolescent-health/New_Publications/NUTRITION/ISBN_92_4_156271_4.pdf)

<sup>14</sup> WHO. (2006) WHO HIV and Infant Feeding Technical Consultation Consensus Statement. Held on behalf of the Inter-agency Task Team (IATT) on Prevention of HIV Infections in Pregnant Women, Mothers and their Infants Geneva, October 25-27, 2006. [http://www.who.int/child-adolescent-health/publications/NUTRITION/consensus\\_statement.htm](http://www.who.int/child-adolescent-health/publications/NUTRITION/consensus_statement.htm)

<sup>15</sup> WHO. Complementary Feeding: Family foods for breastfed children. World Health Organization, Geneva. 2000.

<sup>16</sup> PAHO/WHO. Guiding Principles for Complementary Feeding of the Breastfed Child. Pan American Health Organization. Washington DC, 2003.

<sup>17</sup> WHO. Guiding Principles for Feeding Non-breastfed Children 6-24 months of age. World Health Organization, Geneva. 2005.

(i.e., 6-12 months), as the intake of complementary food increases. Microbial contamination of food and water are the major causes of childhood diarrhoea which can be prevented by implementing food safety measures, such as:

- Washing caregivers' and children's hands before food preparation and eating;
- Storing foods safely and serving foods immediately after preparation;
- Using clean utensils to prepare and serve food;
- Using clean cups and bowls when feeding children;
- Avoiding the use of feeding bottles where adequate cleaning and sterilization is not possible. Feeding bottles are difficult to keep clean and are an important route of transmission of pathogens; and
- Using safe/potable water as a key element to prevent childhood diarrhoea.

See also WHO's Five Keys to Safer Food: <http://www.who.int/foodsafety/consumer/5keys/en>

### References and Further Reading

American Public Health Association (2004). Control of Communicable Diseases Manual 18th Ed

FAO (2004). Family Nutrition Guide. <http://www.fao.org/docrep/007/y5740e/y5740e00.htm>

Kendall P, Medeiros LC, Hillers V, Chen G, DiMascola S. Food handling behaviors of special importance for pregnant women, infants and young children, the elderly, and immune-compromised people. J Am Diet Assoc. 2003 Dec;103(12):1646-9.

WHO (2005). Children's health and the environment. A global perspective.

WHO (1996). Basic Principles for the preparation of safe food for infants and young children. [http://www.who.int/foodsafety/consumer/infant\\_feeding/en](http://www.who.int/foodsafety/consumer/infant_feeding/en)

### Examples of information on Food Safety and Pregnancy issued by national authorities

Food Standards Australia New Zealand:

<http://www.foodstandards.gov.au/foodmatters/pregnancyandfood.cfm>

New Zealand Food Safety Authority: <http://www.nzfsa.govt.nz/consumers/low-immunity-child-pregnancy/pregnancy-food-safety/>

United Kingdom Food Standards Authority: <http://www.eatwell.gov.uk/asksam/agesandstages/pregnancy/>  
<http://www.food.gov.uk/news/newsarchive/2006/dec/infantform>

United States Food and Drug Administration: <http://www.cfsan.fda.gov/~pregnant/pregnant.html>

Food Safety Authority of Ireland: [http://www.fsai.ie/publications/guidance\\_notes/gn22.pdf](http://www.fsai.ie/publications/guidance_notes/gn22.pdf),  
[http://www.fsai.ie/publications/factsheet/factsheet\\_enterobacter\\_sakazakii.pdf](http://www.fsai.ie/publications/factsheet/factsheet_enterobacter_sakazakii.pdf)

Swedish National Food Administration:

[http://www.slv.se/templates/SLV\\_Page.aspx?id=15787&epslanguage=EN-GB](http://www.slv.se/templates/SLV_Page.aspx?id=15787&epslanguage=EN-GB)

New South Wales Food Authority (Australia):

<http://www.foodauthority.nsw.gov.au/consumer/pregnancy.asp>

*INFOSAN serves as a vehicle for food safety authorities and other relevant agencies to exchange food safety information and to improve collaboration among food safety authorities at both the national and international level.*

*INFOSAN Emergency, embedded in INFOSAN, links official national contact points to address outbreaks and emergencies of international importance and allows for the rapid exchange of information. INFOSAN Emergency is intended to complement and support the existing WHO Global Outbreak Alert and Response Network (GOARN).*

*INFOSAN is operated/managed by WHO, Geneva. It currently includes 167 Member States.*

*More information is available at: [www.who.int/foodsafety](http://www.who.int/foodsafety)*