



Microbiological quality of powdered infant formula

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Executive summary

Powdered infant formula (PIF) is readily available, as either a supplement or replacement for breast milk. PIF is heat-treated during processing but, unlike liquid formula products, it is not subjected to sufficient treatment to make the final packaged product commercially sterile. While PIF may not be commercially sterile, its production is undertaken using rigorous hygienic precautions coupled with monitoring of the process environment and finished product by the manufacturer. These activities assist in reducing the microbial load of PIF.

Salmonella species and *Cronobacter sakazakii* (formerly known as *Enterobacter sakazakii*) have been identified as the organisms of greatest concern with PIF (FAO/WHO, 2004 & 2006). Due to the limited available data, a survey was conducted to gather information on the microbiological quality of these products sold in NSW.

From September 2009 to December 2010, a total of 91 powdered formulas and three ready-made formulas were purchased from retailers in Sydney. At least one sample from each product range available in the market was included in this survey. Samples were tested for *Salmonella*, *C. sakazakii*, and *Enterobacteriaceae*. Results obtained from this survey were compared against the microbiological requirements (*Standard 1.6.1*) of the Australian New Zealand Food Standards Code (the Code). Organisms that are not included in *Standard 1.6.1* were assessed against the CODEX Microbiological criteria for powdered infant formula (excluding follow-on formula) as specified in the *Code of hygienic practice for powdered formulae for infants and young children* (CAC/RCP 66 – 2008).

The survey found that 100% of products tested met the limits for *Salmonella* and *C. sakazakii* specified in the Code and CAC/RCP 66 – 2008. *Enterobacteriaceae* was detected in three samples at a low level. The relevant manufacturers were notified of the findings.

Control strategies are required not only during manufacturing but also during the rehydration, use and handling of PIF. If present, pathogens can pose a potential risk after rehydration (especially if the rehydrated product is temperature abused). Contamination may also occur as a result of the equipment or utensils (eg bottles, spoons etc) used for preparing PIF. A recommendation for the safe preparation and use of PIF was subsequently developed and is available on the Authority's website.

1. Introduction

Powdered infant formula (PIF) is readily available, as either a supplement to or replacement for breast milk. PIF is heat-treated during processing but, unlike liquid formula products, it is not subjected to sufficient treatment to make the final packaged product commercially sterile. While PIF may not be commercially sterile, its production is undertaken using rigorous hygienic precautions coupled with monitoring of the process environment and finished product by the manufacturer. These activities assist in reducing the microbial load of PIF.

Salmonella and *Cronobacter sakazakii* (formerly classified as *Enterobacter sakazakii*) have been identified as the organisms of greatest concern with PIF (FAO/WHO, 2004 & 2006). To date, no cases of illness in infants linked to the consumption of infant formula have been reported in Australia.

Salmonella is a well known foodborne human pathogen. Overseas, at least six reported outbreaks of salmonellosis involving approximately 250 infants were associated with PIF between 1985 and 2009 (Appendix 1). Most of the outbreaks involved unusual *Salmonella* serotypes, which assisted in outbreak investigations. It has been suggested that outbreaks and sporadic cases of salmonellosis due to PIF are likely to be under-reported (FAO/WHO, 2006).

C. sakazakii is an opportunistic pathogen emerging as a public health concern. Considerable progress has been made in understanding the ecology of this organism, but there is still little known about its pathogenesis and virulence factors. Infections from *C. sakazakii* have been reported as both sporadic cases and outbreaks. The primary manifestations of *C. sakazakii* infection in infants include meningitis and bacteraemia, which tend to vary with age. Reported fatality rates of *C. sakazakii* infections in infants vary considerably with rates as high as 50% reported in at least one outbreak (Appendix 1). In addition, a portion of surviving infants has permanent disabilities such as retardation and other neurological conditions. In some of these outbreaks and cases, PIF was established as the source of the infections. In many, the exact source could not be determined.

Ten studies determining the microbiological quality of commercial powdered infant formula were identified by a literature search. *C. sakazakii* was detected in seven of the studies with prevalence rates ranging from 0.5% to 25% (Appendix 2). Three of the studies also performed quantitative tests and *C. sakazakii* was detected at levels from 0.36 cfu/100g up to 66 cfu/100g (Muytjens et al., 1988; Nazarowec-White & Farber, 1997; Zink, 2003). *Salmonella* was tested in five surveys and was not detected in any of the formula tested (Estuningsih et al, 2006; Iversen & Forsythe, 2004; Muytjens et al, 1988; Thompson, 2010).

To date, there is limited public information in Australia on the microbiological quality of powdered infant formula. One PIF sample from Australia tested positive for *C. sakazakii* in the survey reported by Muytjens et al. (1988) at the level of 0.36 cfu/100g. However, no data was provided on the number of samples actually taken from Australia in that survey and it is likely that this result does not reflect recent changes in the production of PIF that are likely to influence the microbiological quality of PIF. The most recent survey conducted by the South Australian Government did not find any pathogens in the twenty samples tested (Thompson, 2010).

In 2008, a suspected case of foodborne illness initially linked to infant formula took place in South Australia. Further investigation found that the illness was not actually due to the product, but due to poor of hygiene and improper handling of reconstituted infant formula. The incident, however, highlighted the lack of available data on microbiological quality of infant formula in Australia. Thus, a survey was conducted to gather information on the microbiological quality of these products sold in NSW. The information collected on the microbiological quality of powdered infant formula will supplement the communication message on the safe handling of powdered infant formula that was developed for consumers and caregivers and is available on the NSW Food Authority website.

2. Method of analysis

From September 2009 to December 2010, 91 powdered infant formulas and three ready-made formulas were purchased from supermarkets, pharmacies and health food stores in Sydney. At least one sample from each product range available in the market was tested in this survey.

For the purpose of this survey, samples were divided into three categories:

Category A: Powdered infant formula that target infants from birth (infant formula)

Category B: Powdered infant formula that target infants aged 6 to 12 months (follow-on formula)

Category C: Powdered infant formula that target young children aged 12+ months (formulated complementary food for your children¹)

All samples were kept hermetically sealed at room temperature after purchase and tested within the use-by date using the method outlined in Table 1.

Table 1. Methods used in the analysis of samples

Microorganisms	Method	Limit of detection	Limit of detection range (MPN/g)	95%CI (MPN/g)
<i>Salmonella</i> detection	AS 1766.2.5	Presence/absence in 5x25g samples	<0.007 to 0.02	0 to 0.06
<i>Cronobacter sakazakii</i> detection	ISO/TS 22964:2006	Presence/absence in 5x10g samples	<0.02 to 0.06	0 to 0.14
<i>Enterobacteriaceae</i> detection and enumeration	ISO 21528-1/21528-2	Presence/absence in 10g and <0.3MPN/g		

Results obtained from this survey were compared against the microbiological requirements (*Standard 1.6.1*) of the Australian New Zealand Food Standards Code (the Code). Organisms that are not included in *Standard 1.6.1*, were assessed against the CODEX Microbiological criteria for powdered infant formula (excluding follow-on formula) as specified in the *Code of hygienic practice for powdered formulae for infants and young children* (CAC/RCP 66 – 2008). The summary of the microbiological requirements is outlined in Table 2.

Table 2. Microbiological requirements for powdered infant formula²

Microorganisms	Microbiological criteria	Source
<i>C. sakazakii</i>	Not detected in 10g	CAC/RCP 66 – 2008
<i>Enterobacteriaceae</i>	Not detected in 10g	CAC/RCP 66 – 2008
<i>Salmonella</i>	Not detected in 25g	<i>Standard 1.6.1</i> of the Code

¹ Standard 2.9.3 of the Food Standard Code defines formulated supplementary food for young children as a formulated supplementary food for children aged one to three years. The Standard further defines formulated supplementary food as a food specifically designed as a supplement to a normal diet to address situations where intakes of energy and nutrients may not be adequate to meet an individual's requirements.

² Since testing was only done on a single sample from a batch, the number of subsamples was less than the prescribed sample unit number specified in the Code or CAC/RCP 66 – 2008.

3. Results and discussion

A summary on the microbiological results is shown in Table 3. No pathogenic bacteria were detected in any of the 94 samples tested. The hygiene indicator *Enterobacteriaceae* was detected in three samples.

Table 3. Microbiological results for powdered infant formula and ready-made formula

Product	No of samples	Pathogenic bacteria		Hygiene indicator
		<i>Salmonella</i>	<i>E. sakazakii</i>	<i>Enterobacteriaceae</i> (% of category)
Infant formula	57	0	0	2 (3.5%)
Follow-on formula	19	0	0	1 (5.3%)
Formulated complementary food for young children	18	0	0	0

In this survey, no samples were positive for *Salmonella*, which is consistent with the findings of other surveys, which collectively tested approximately 1100 samples (Estuningsih et al., 2006; FSAI, 2007; Iversen & Forsythe, 2004; Muytjens et al., 1988; Thompson, 2010).

C. sakazakii was also not detected in any of the samples analysed in this survey. This result is comparable to, if not better than, findings from previous studies. Seven studies carried out overseas and reported in the scientific literature detected *C. sakazakii* in samples with a prevalence range of 0.5% to 25% (Chap et al., 2009; Estuningsih et al., 2006; FSAI, 2007; Iversen & Forsyth, 2004; Muytjens et al., 1988; Nazarowec-White & Farber, 1997; Palcich et al., 2009; Shaker et al., 2007; Zink, 2003).

In recent years manufacturers of PIF have implemented strategies to control *Salmonella* and *C. sakazakii*, which may explain the absence of these pathogens in this survey compared with earlier surveys.

The safe production of these products is also dependent on maintaining a high level of hygienic control. Therefore, *Enterobacteriaceae* was also tested for in this survey and used as a hygiene indicator. The inclusion of this testing is not intended to be used for assessing the safety of a specific lot of product. Instead, it is intended to be used for verification of the hygiene programs. *Enterobacteriaceae* were detected in two infant formula and one follow-on formula at low level (two samples contained the organism at less than 0.3 MPN³/g and one sample was at 9.3 MPN/g). The manufacturers of those products were notified of the findings. For the sample that contained 9.3 MPN/g of *Enterobacteriaceae*, another batch of the same product was tested and was negative for the organism.

Control strategies are required not only during manufacturing but also during the rehydration, use and handling of PIF. If present, pathogens can pose a potential risk after rehydration (especially if the rehydrated product is temperature abused). Contamination may also occur as a result of the equipment or utensils (eg bottles, spoons etc) used for preparing PIF. A recommendation for the safe feeding of PIF was subsequently developed and is available on the Authority's website.

4. Conclusion

The survey found that all 94 products tested met the limits for *Salmonella* and *C. sakazakii* specified in the Code and CAC/RCP 66 – 2008.

³ MPN/g denoted most probable number per gram or organisms per gram

5. References

- Biering, G., Karlsson, S., Clark, N.C., Jónsdóttir, K., Lúdvígsson, P. & Steingrímsson, Ó. (1989). Three cases of neonatal meningitis caused by *Enterobacter sakazakii* in powdered milk. *Journal of Clinical Microbiology*, 27(9), 2054-2056.
- Block, C., Peleg, O., Minster, N., Bar-Oz, B., Simhon, A., Aras, I., & Shapiro, M. (2002). Cluster of neonatal infections in Jerusalem due to unusual biochemical variant of *Enterobacter sakazakii*. *European Journal of Clinical Microbiology and Infectious Diseases*, 21, 613-616.
- CDC. (2009). Cronobacter species isolation in two infants – New Mexico, 2008. *MMWR Weekly*, 58(42), 1179 – 1183. Retrieved October 30, 2009 from <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5842a3.htm>
- CDSC. (1997). *Salmonella anatum* infection in infants linked to dried milk. *Communicable Disease Report Weekly*, 7(5). Retrieved May 20, 2008 from Health Protection Agency Website: <http://www.hpa.org.uk/cdr/archives/1997/cdr0597.pdf>
- CDSC. (2001). Infant botulism: update. *Communicable Disease Report Weekly*, 11(33). Retrieved May 20, 2008 from Health Protection Agency Website: <http://www.hpa.org.uk/cdr/archives/2001/cdr3301.pdf>
- Chap, J., Jackson, P., Siqueira, R., Gaspar, N., Quintas, C., Park, J., Osaili, T., Shaker, R., Jaradat, Z., Hartantyo, S.H.P., Abdullah Sani, N., Estuningsih, S. & Forsythe, S.J. (2009). International survey of *Cronobacter sakazakii* and other *Cronobacter* spp. in follow up formulas and infant foods. *International Journal of Food Microbiology*, 136, 185 – 188.
- Codex Alimentarius Commission. (2008). Code of hygienic practice for powdered formulae for infants and young children CAC/RCP 66 – 2008. Retrieved May 26, 2008 from Codex Web site: www.codexalimentarius.net/download/standards/11026/cxp_066e.pdf
- Codex Committee on Food Hygiene. (2004a). *Risk profile of Enterobacter sakazakii and other microorganisms in powdered infant formula*. Retrieved May 26, 2008 from FAO Web site: ftp://ftp.fao.org/codex/ccfh36/fh04_12e.pdf
- Codex Committee on Food Hygiene. (2004b). Joint FAO/WHO meeting on *Enterobacter sakazakii* and other microorganisms in powdered infant formula. Retrieved May 26, 2008 from FAO Web site: <ftp://ftp.fao.org/codex/ccfh36/fh0412ae.pdf>
- Coignard, B. & Vaillant, V. (2006). *Infections à Enterobacter sakazakii associées à la consommation d'une préparation en poudre pour nourrissons. France, octobre à décembre 2004. Rapport d'investigation*. Abstract retrieved May 20, 2008 from INVS Website: http://www.invs.sante.fr/display/?doc=publications/2006/infections_e_sakazakii/index.html
- Estuningsih, S., Kress, C., Hassan, A.A., Akineden, Ö., Schneider, E., & Usleber, E. (2006). *Enterobacteriaceae* in dehydrated powdered infant formula manufactured in Indonesia and Malaysia. *Journal of Food Protection*, 69(12), 3013-3017.
- FAO/WHO. (2004). *Enterobacter sakazakii* and other microorganisms in powdered infant formula: meeting report, Microbiological Risk Assessment Series 6. Retrieved January 13, 2009 from WHO Web site: <http://www.who.int/foodsafety/publications/micro/es.pdf>
- FAO/WHO. (2006). *Enterobacter sakazakii* and Salmonella in powdered infant formula: meeting report, Microbiological Risk Assessment Series 10. Retrieved May 26, 2008 from FAO Web site: <ftp://ftp.fao.org/docrep/fao/009/a0707e/a0707e00.pdf>
- Food Safety Authority Ireland. (2007). Microbiological safety of dried infant formulae and dried dietary foods for special medical purposes intended for infants below 6 months of age. Retrieved February 6, 2009 from FSAI Web site: http://www.fsai.ie/surveillance/food_safety/microbiological/infants.pdf

Food Standards Australia New Zealand. (2008). *Australia New Zealand Food Standards Code*. Retrieved May 26, 2008 from FSANZ Web site: <http://www.foodstandards.gov.au/thecode/foodstandardscode.cfm>

Himelright, I., Harris, E., Lorch, V., Anderson, M., Jones, T, et al. (2001). *Enterobacter sakazakii* infections associated with the use of powdered infant formula – Tennessee. *Morbidity and Mortality Weekly Report*, 51(14), 298-300. Retrieved January 19, 2009 from CDC Website: <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5114a1.htm>

Iversen, C. & Forsythe, S. (2004). Isolation of *Enterobacter sakazakii* and other Enterobacteriaceae from powdered infant formula milk and related products. *Food Microbiology*, 21, 771-777

Jourdan, N., Le Hello, S., Delmas, G., Clouzeau, J., Manteau, C., Dęsaubliaux, B., Chagnon, V., Thierry-Bled, F., Demare, N., Weill, F.X. & de Valk, H. (2008). Nationwide outbreak of *Salmonella enterica* serotype Give infections in infants in France, linked to infant milk formula, September 2008. *Eurosurveillance*, 13(39).

Louie, K.K., Paccagnella, A.M., Lior, H., Francis, B.J., & Osterholm, M.T. (1993). Salmonella serotype Tennessee in powdered milk products and infant formula – Canada and United States 1993. *Morbidity and Mortality Weekly Report*, 42(26), 516-517. Retrieved January 19, 2009 from CDC Website: <http://www.cdc.gov/mmwr/preview/mmwrhtml/00021081.htm>

Ministry of Health New Zealand. (2005). *Inquiry into actions of sector agencies in relation to contamination of infant formula with Enterobacter Sakazakii*. Retrieved May 20, 2008 from MOH NZ Website: <http://www.moh.govt.nz/moh.nsf/ea6005dc347e7bd44c2566a40079ae6f/6de04e6c28e24e87cc256fe8000f2415?OpenDocument>

Muytjens, H.L., Roelofs-Willemse, H., & Jaspar, G.H.J. (1988). Quality of powdered substitutes for breast milk with regard to members of the family *Enterobacteriaceae*. *Journal of Clinical Microbiology*, 26(4), 743-746.

Nazarowec-White, M. & Farber, J.M. (1997). Incidence, survival, and growth of *Enterobacter sakazakii* in infant formula. *Journal of Food Protection*, 60(3), 226-230.

Palcich, G., de Moraes Gillio, C., Aragon-Alegro, L.C., Pagotto, F.J., Farber, J.M., Landgraf, M., & Destro, M.T. (2009). *Enterobacter sakazakii* in dried infant formulas and milk kitchens of maternity wards in Sao Paulo, Brazil. *Journal of Food Protection*, 72(1), 37 – 42.

Rowan, N.J. & Anderson, J.G. (1998). Diarrhoeal enterotoxin production by psychrotrophic *Bacillus cereus* present in reconstituted milk-based infant formulae (MIF). *Letters in Applied Microbiology*, 26, 161-165.

Shaker, R., Osaili, T., Al-Omary, W., Jaradat, Z. & Al-Zuby, M. (2007). Isolation of *Enterobacter sakazakii* and other *Enterobacter* sp. From food and food production environments. *Food Control*, 18(10), 1241 – 1245.

Soler, P., Herrera, S., Rodriguez, J., Cascante, J., Cabral, R., Echeita-Sarriondia, A. & Mateo, S. (2008). Nationwide outbreak of *Salmonella enterica* serotype Kedougou infection in infants linked to infant formula milk. *Eurosurveillance*, 13(7-9).

Threlfall, E.J., Ward, L.R., Hampton, M.D., Ridley, A.M., Rowe, B., et al. (1998). Molecular fingerprinting defines a strain of *Salmonella enterica* serotype Anatum responsible for an international outbreak associated with formula-dried milk. *Epidemiology and Infection*, 121, 289-293.

Thompson, T. Food safety survey report Microbiological quality of infant formula. Government of South Australia Food Act Report Year ending 30 June 2010. Retrieved November 20, 2010 from <http://www.health.sa.gov.au/pehs/publications/FoodActReport-PEHS-2010.pdf>

Van Acker, J., De Smet, F., Muyldermans, G., Bougateg, A., Naessens, A., & Lauwers, S. (2001). Outbreak of necrotizing enterocolitis associated with *Enterobacter sakazakii* in powdered milk formula. *Journal of Clinical Microbiology*, 39(1), 293-297.

Zink, D.L. (2003). FDA field survey of powdered formula manufacturing. Paper presented at Contaminant and Natural Toxicants Subcommittee of the Food Advisory Committee Center for Food Safety and Applied Nutrition (CFSAN) Food and Drug Administration (FDA) Meeting, Maryland. Retrieved May 20, 2008 from http://www.fda.gov/ohrms/dockets/ac/03/slides/3939s1_Zink.ppt

Appendix 1. Epidemiological data that implicate powdered infant formula

Year	Country	Organisms	Cases (deaths)	Reference
2008	USA	<i>E. sakazakii</i>	2	CDC, 2009
2008	France	<i>S. Give</i>	6	Jourdan et al., 2008
2008	Spain	<i>S. Kedougou</i>	23	Soler et al., 2008
2005	France	<i>S. Agona</i>	104	FAO/WHO, 2006
2004	France	<i>E. sakazakii</i>	9 (2)	Coignard & Vaillant, 2004
2004	New Zealand	<i>E. sakazakii</i>	4 (1)	Ministry of Health NZ, 2005
2001	United Kingdom	<i>C. botulinum</i> type B	1	CDSC, 2001
2001	United States	<i>E. sakazakii</i>	11 (1)	Himelright et al., 2001
2000	Korea	<i>S. London</i>	30	Park et al., 2004
1999-2000	Israel	<i>E. sakazakii</i>	2	Block et al., 2002
1998	Belgium	<i>E. sakazakii</i>	12 (2)	Van Acker et al., 2001
1997	United Kingdom	<i>S. Anatum</i>	17	CDSC, 1997
1996	Spain	<i>S. Virchow</i>	48	Usera et al., 1998
1993	Canada & United States	<i>S. Tennessee</i>	3	Louie, Paccagnella, Lior, Francis, & Osterholm, 1993
1986-87	Iceland	<i>E. sakazakii</i>	3 (1)	Biering et al., 1989
1985	United Kingdom	<i>S. Ealing</i>	48	Rowe et al., 1987

Appendix 2. Previous studies

Year	Country	Organisms	No of samples tested	No of positive samples	Level (cfu/100g)	Reference
2010	Australia (SA)	<i>B. cereus</i> <i>Staphylococcus</i> Coliforms <i>Salmonella</i> SPC	20	0		Thompson, 2010
Unknown	Brazil, Korea, Malaysia, UK, Indonesia, Portugal & Jordan	APC <i>Cronobacter</i> spp	136 (follow-on formula)	3 >10 ⁵ cfu/g 1 (0.7%)		Chap et al., 2009
2006	Brazil	<i>E. sakazakii</i> <i>Enterobacteriaceae</i>	186	1 (0.5%) 1 (0.5%)	0.3 5	Palcich et al, 2009
2006	Ireland	<i>E. sakazakii</i> <i>Salmonella</i>	719	0 0		FSAI, 2007
Unknown	Jordan	<i>E. sakazakii</i>	8	2 (25%)		Shaker et al., 2007
Unknown	Indonesia	<i>Salmonella</i> <i>Shigella</i> <i>Enterobacteriaceae</i> <i>E. sakazakii</i>	74	0 0 35 (47.3%) 10 (13.5%)		Estuningsih et al., 2006
2003	UK	APC <i>Enterobacteriaceae</i> <i>E. sakazakii</i> <i>Salmonella</i>	82	2 >10 ⁴ cfu/g 9 (11%) 2 (2.4%) 0		Iversen & Forsythe, 2004
Unknown	USA	<i>E. sakazakii</i>	22	5 (22.7%)	0.36	Zink, 2003
Unknown	UK	<i>B. cereus</i>	100	38 (38%)		Rowan & Anderson, 1998
Unknown	Canada	<i>E. sakazakii</i>	120	8 (6.7%)	0.36	Nazarowec-White & Farber, 1997
Unknown	The Netherlands (samples from 35 countries)	<i>Enterobacteriaceae</i> <i>E. sakazakii</i> <i>Salmonella</i>	141	74 (52.5%) 20 (14.2%) 0	0.36 to 66	Muytjens, Roelofs-Willemse, Jaspas, 1988

Appendix 3. Survey result⁴

Date of sampling	Sample number	Category	<i>Salmonella</i> (5x25g)					<i>E. sakazakii</i> (5x10g)					Enterobacteriaceae (10g)	Enterobacteriaceae (MPN/g)	
			a	b	c	d	e	a	b	c	d	e	a	a	
23/04/2009	1136	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
23/04/2009	1137	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
23/04/2009	1138	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
23/04/2009	1139	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
23/04/2009	1140	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
23/04/2009	1141	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
23/04/2009	1142	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
23/04/2009	1143	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
23/04/2009	1148	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
23/04/2009	1150	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
23/04/2009	1151	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
23/04/2009	1153	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
23/04/2009	1155	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
23/04/2009	1157	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	Detected	9.3	
23/04/2009	1158	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3	
23/04/2009	1159	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3	

⁴ ND: Not Detected

Date of sampling	Sample number	Category	<i>Salmonella</i> (5x25g)					<i>E. sakazakii</i> (5x10g)					Enterobacteriaceae (10g)	Enterobacteriaceae (MPN/g)	
			a	b	c	d	e	a	b	c	d	e	a	a	
23/04/2009	1160	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
23/04/2009	1162	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
23/04/2009	1163	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
12/03/2010	1745	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
19/04/2010	1751	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
19/04/2010	1752	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
11/10/2009	6500	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
11/10/2009	6501	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
11/10/2009	6502	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
11/10/2009	6503	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
11/10/2009	6504	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
11/10/2009	6505	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6506	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6507	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6508	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6509	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6510	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6511	Formulated supplementary food	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3

Date of sampling	Sample number	Category	<i>Salmonella</i> (5x25g)					<i>E. sakazakii</i> (5x10g)					Enterobacteriaceae (10g)	Enterobacteriaceae (MPN/g)
			a	b	c	d	e	a	b	c	d	e	a	a
		for young children												
14/10/2009	6512	Infant formula – ready-made	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6513	Follow-on formula – ready made	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6514	Formulated supplementary food for young children – ready-made	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6515	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6516	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6517	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6518	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6519	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6520	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6521	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	Detected	<0.3
14/10/2009	6522	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6523	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6524	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6525	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6526	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3

Date of sampling	Sample number	Category	<i>Salmonella</i> (5x25g)					<i>E. sakazakii</i> (5x10g)					Enterobacteriaceae (10g)	Enterobacteriaceae (MPN/g)	
			a	b	c	d	e	a	b	c	d	e	a	a	
14/10/2009	6527	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6529	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6530	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6531	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6532	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	Detected	<0.3	
14/10/2009	6533	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6535	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6536	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6537	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6538	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6539	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6540	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
14/10/2009	6541	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
26/10/2009	6542	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
26/10/2009	6543	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
26/10/2009	6544	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
26/10/2009	6545	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3

Date of sampling	Sample number	Category	<i>Salmonella</i> (5x25g)					<i>E. sakazakii</i> (5x10g)					Enterobacteriaceae (10g)	Enterobacteriaceae (MPN/g)	
			a	b	c	d	e	a	b	c	d	e	a	a	
26/10/2009	6546	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
26/10/2009	6547	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
26/10/2009	6548	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
26/10/2009	6549	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
12/11/2009	6550	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
12/11/2009	6551	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
25/11/2009	6552	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
25/11/2009	6553	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
25/11/2009	6554	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
25/11/2009	6555	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
25/11/2009	6556	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
25/11/2009	6557	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
16/02/2009	8511	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
16/02/2009	8512	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3

Date of sampling	Sample number	Category	<i>Salmonella</i> (5x25g)					<i>E. sakazakii</i> (5x10g)					Enterobacteriaceae (10g)	Enterobacteriaceae (MPN/g)	
			a	b	c	d	e	a	b	c	d	e	a	a	
16/02/2009	8513	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
16/02/2009	8514	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
16/02/2009	8515	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
16/02/2009	8517	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
16/02/2009	8518	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
16/02/2009	8519	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
16/02/2009	8520	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
16/02/2009	8521	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
16/02/2009	8522	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
16/02/2009	8523	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
16/02/2009	8524	Infant formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
16/02/2009	8525	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
16/02/2009	8526	Follow-on formula	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3
16/02/2009	8528	Formulated supplementary food for young children	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.3

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