



Vol. 21, No. 2
2004

In-Touch



Heinz Infant Nutrition Institute

CELEBRATING TWENTY ONE YEARS OF INFANT NUTRITION EDUCATION

Breast Milk Substitutes – An Update

Lynda Lowry, M.S., PHEc.
Nutrition Consultant
Neepawa, MB



Breastfeeding is the optimal method of feeding human infants. Current recommendations in Canada and the United States are to breastfeed infants for the first year of life^{1,2}. However, for those families that choose not to breastfeed, commercial formulas are recommended as the next best choice.

As researchers characterize the complex components of breast milk, modifications to human milk substitutes have been made in an attempt to produce formulas that closely match this gold standard. While these combinations of nutrients, emulsifiers and stabilizers produce formulas that are safe and wholesome, they are missing the immune factors, hormones, antimicrobial agents, antioxidants and enzymes that make human milk superior and species specific.

A review of commercial infant formula was published in the Spring 1996 issue of *In-Touch*. Since that time, two new store brands have entered the market place in Canada (President's Choice [Superstore] and Parent's Choice [Wal-Mart]), and Bonamil and SMA have been discontinued. Carnation formulas available in 1996 are now sold with the Nestle label including a value-priced product in the U.S. called Good Start Essentials. Two product lines in Canada and three in the U.S. have added long chain polyunsaturated fatty acids (LCPUFA) to the fat blend.

This current review includes U.S. and Canadian products for the healthy term infant and does not include soy products or protein hydrolysate formulas. A future article in *In-Touch* will review those products. Most companies that distribute products in both countries have similar formulations with only slight differences due to specific labelling regulations and nutrient requirements of Health Canada and the U.S. Food and Drug Administration. The information for this article was collected in January and February 2004 and may be subject to change at any time. The information was gathered from websites, labels, product guides and personal communication with company representatives. Every effort has been made to ensure that the information provided is up-to-date and accurate but changes occur regularly and health professionals are reminded to check labels to ensure accuracy of advice to clients.

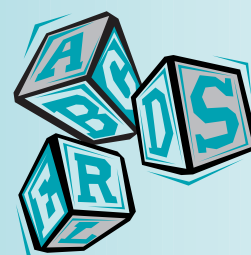
Parents are faced with a wide choice of products that meet Health Canada and FDA requirements to be called a human milk substitute. This is not to say that all products are the same, however. Different brands may include additional amino acids or fatty acids, minerals and vitamins. Table 1 compares regular formulas, those with different carbohydrate sources and a new category with added fatty acids as well as the second stage products for the infant over six-months-of-age who is receiving solid foods. These values are for Canadian products. Health professionals in the U.S. are advised to check U.S. labels for comparison.

As recommended by the Canadian Pediatric Society¹ and the American Academy of Pediatrics², most infant formulas are iron-fortified. Only Enfalac (in Canada)

In This Issue:

**Breast Milk Substitutes
– An Update** 1

**CLIENT HANDOUT:
Infant Formula Preparation
Guidelines**



To review articles from past issues of *In-Touch* and to access additional articles on infant nutrition, visit the HINI website at www.hini.org.

HINI Advisory Council:

L. Clark Lowry, M.S. PHEc.
Nutrition Consultant
Neepawa, MB

J. K. Friel, Ph.D.
Professor and Head
Human Nutritional Sciences
University of Manitoba, Winnipeg, MB

R. Hanning, Ph.D., RD
Associate Professor
Department of Health Studies & Gerontology
University of Waterloo, Waterloo, ON

I. Laquatra, Ph.D., RD
Nutrition Consultant
Pittsburgh, PA

D. Secker, M.S., RD
Clinical Dietitian
The Hospital for Sick Children
Toronto, ON

D.L. Yeung, Ph.D.
General Manager of Global Nutrition Services
H.J. Heinz Company, Toronto, ON

Editor: D.L. Yeung, Ph.D.

Managing Editor: I. Laquatra, Ph.D., RD

ERRATUM:

The patient handout on allergies included in issue Volume 20, Number 2, 2003 incorrectly listed buckwheat in the gluten list. Breads and baked products containing buckwheat are permitted on a gluten-free diet.

(Enfamil in U.S.), Similac Advance, and President's Choice have a regular formula as well as one that is iron-fortified. The low-iron Similac Advance formula will be discontinued in 2004³. Parents must play close attention when making purchases as there may or may not be a significantly different label for each form.

Selenium is present in greater quantities in human milk than in non-supplemented formulas. Selenium intakes of infants fed

Selenium intakes of infants fed non-fortified formulas are reported to be lower than recommended.

non-fortified formulas are reported to be lower than recommended. Table 1 compares the selenium levels in the various brands of formula. "Selenium is best known for its role as an antioxidant as a component of the glutathione peroxidase enzymes that

protect cell membranes from oxidative damage. Human milk contains 15-20 ug/L. Unsupplemented formulas contain 2 – 13 and supplemented products have 15-20 ug/L. The selenium intakes of infants fed formulas without supplements are reported to be near or below recommended intakes"⁴.

Infant formula companies add a variety of compounds for which there is no recommended intake, but which are present in human milk. These amino acids (taurine [an aminosulfonic acid] and cystine), non-vitamins (inositol and l-carnitine) and the B-Vitamin choline are added to several formulas with unknown clinical significance. On the other hand, molybdenum is an essential nutrient for infants and it is not added to commercial formulas. Similarly, human milk is rich in cholesterol but it is not added to commercial formulas, based on the assumption that infants will endogenously synthesize their own cholesterol.

Studies suggest that dietary nucleotides have a role in the development of the immune and the gastro-intestinal systems. Two human studies show that the addition of nucleotides to breast milk substitutes may protect against diarrheal disease and boost the serum concentration of some antibodies⁵. Nucleotides are added to some, but not all, formulas (Table 1). The concentration of nucleotides in human milk is higher than in non-supplemented commercial formula but similar to supplemented products.

TABLE 1. NUTRITIONAL ANALYSIS OF BREAST MILK SUBSTITUTES /100 ml RECONSTITUTED

Formula		Parent's Choice	President's Choice	Similac Advance with DHA and ARA	Similac Advance Step 2	Similac Advance LF
Age		0-12 months	0-12 months	0-12 months	6-18 months	0-12 months
Distributor		Wal*Mart	Superstore, Loblaws	Ross Pediatrics	Ross Pediatrics	Ross Pediatrics
Energy	cal	68	68	68	68	68
Protein Source		skim milk powder	skim milk powder	non-fat milk & whey	non-fat milk & whey	cow's milk
Protein	g	1.45	1.45	1.4	1.4	1.5
Fat Source		high oleic safflower or sunflower, coconut, soybean oils	high oleic safflower, coconut, soybean oil	palm olein free high oleic safflower sunflower, soy, coconut	high oleic safflower/ sunflower, soy and coconut	high oleic safflower sunflower, soy and coconut oils
Fat	g	3.65	3.65	3.7	3.7	3.7
Linoleic acid	g	0.55	0.55	0.55	0.55	0.55
Linolenic acid	g	0.072	0.072	0.072	0.072	0.072
Carbohydrate Source		lactose	lactose	lactose	lactose	50% corn syrup 50 % sucrose no lactose
Carbohydrate	g	7.2	7.2	7.3	7.1	7.2
Sodium	mg	18	18	16	16	20
Iron	mg	1.2	regular 0.15 iron fortified 1.2	1.2	1.2	1.2
nucleotides	mg	3	3	7.2	7.2	7.2
folic acid	mg	0.01	0.01	0.01	0.01	0.01
Vitamin B12	ug	0.15	0.15	0.17	0.17	0.15
selenium	mg	0.0015	0.00155	0.00155	0.0015	0.0015
calcium	mg	49	49	53	80	57
phosphorous	mg	38	38	28	43	36
potassium	mg	71	71	71	71	72
choline	mg	8.2	8.2	11	11	8.2
taurine	mg	4.5	4.5	3.7	3.7	4.5
cystine	mg	-	-	26.6	26.6	22
inositol	mg	-	-	3.2	-	4
L-carnitine	mg	-	-	-	-	1.1

Most formula fat blends are lower in palmitic acid and oleic acid content than human milk. Palm olein, a lower-melting fraction of palm oil is rich in palmitic acid and oleic acid and is added to some products (Mead Johnson and Nestle). However, when palm olein provides the major proportion (53%) of the fat blend, it has been found to reduce fat and calcium absorption in human infants when compared with formulas containing coconut oil and soy oil⁶. Once again, the long term clinical significance has not been determined from these short-term, metabolic balance studies. Most products contain a variety of fat sources in order to achieve a fatty acid profile that approximates breast milk.

Lactose-Free Formulas

All regular cow's milk formulas contain lactose. However, Similac Advance LF and Enfalac LactoFree contain corn syrup solids and/or sucrose instead. These products are intended for infants with secondary lactose-intolerance following a gastro-intestinal disorder. Lactose-free formulas are usually used for two to four weeks after which regular cow's milk formula can be reintroduced⁷.

Long Chain Polyunsaturated Fatty Acids (LCPUFA)

A new category of formulas with added arachidonic acid (AA) and docosahexaenoic (DHA) fatty acids has recently entered the marketplace. These long chain polyunsaturated fatty acids are extracted from unicellular algae and unicellular fungus and mixed with high oleic sunflower oil to achieve the desired fatty acid profile.

Term infants are able to make their own DHA and AA from linolenic acid and linoleic acid found in all formulas. However, because serum levels of breastfed infants are higher than infants given unsupplemented formula, there has been interest in adding these compounds.

There are contradictory findings about the clinical significance of these added fatty acids. Some research suggests that formulas enriched with LCPUFA provide additional benefits for infant brain development and better visual acuity than non-supplemented formulas^{8,9}. In a review by Carver¹⁰, she notes that there have been more than two dozen studies in the last ten years that report the effects of long-chain polyunsaturated supplements

Unilac	Good Start	Follow-Up	Enfalac	Enfamil A+	Enfalac Next Step	Enfalac LactoFree
0-12 months	0-12 months	6-18 months	0-12 months	0-12 months	6-12 months	0-12 months
Zellers	Nestle	Nestle	Mead Johnson	Mead Johnson	Mead Johnson	Mead Johnson
68	67	67	67	67	67	67
skim milk	100% whey (partially hydrolyzed reduced minerals whey protein concentrate)	skim milk pwdr	reduced mineral whey, non-fat milk whey: casein 60:40	reduced mineral whey, non-fat milk whey: casein 60:40	whey: casein 18:82 non-fat milk	whey: casein 18:82 cow's milk protein
1.5	1.5	1.7	1.4	1.4	1.7	1.4
soybean oil, coconut oil	palm olein, soybean oil, coconut, high monounsaturated safflower oil	palm olein, soybean oil, coconut oil, high mono safflower oil	palm olein, soy, coconut, high oleic sunflower oils	palm olein, soy, coconut, high oleic sunflower, 23 mg ARA & 1.5 mg DHA	palm olein soy, coconut high oleic sunflower oils	high oleic sunflower, palm olein, soy, coconut
3.6	3.4	2.8	3.6	3.6	3.4	3.5
0.92	0.57	0.45	0.6	0.6	0.6	0.6
N/A	0.063	0.049	0.06	0.06	0.06	0.06
lactose	lactose, corn maltodextrin	corn syrup, corn maltodextrin	lactose	lactose	lactose, corn syrup solids	corn syrup solids
7	7.5	8.9	7.4	7.4	7.4	7.3
20	16	26	18	18	27	20
1.2	1	1.2	regular .45 iron fortified 1.2	1.2	1.2	1.2
-	2.6	-	2.8	2.8	-	-
0.005	0.01	0.011	0.01	0.01	0.01	0.01
0.13	0.15	0.2	0.2	0.2	0.2	0.2
-	-	-	0.002	0.002	0.002	0.002
50	43	80	52	52	80	55
37.5	24	54	36	36	52	37
75	66	90	72	72	90	74
9	8.1	8.1	8	8	11	8
-	5.4	-	4	4	4	4
-	-	-	-	-	-	-
-	12	12	4	4	12	11
-	1.1	-	-	-	-	1.3

on growth, cognitive development and visual acuity in infants. Most reports showed normal growth, advantages in visual acuity and inconsistent results in cognitive development¹¹. The long term effects of adding LCPUFAs to infant formula remain to be determined.

In Canada, Enfamil A+ has been available for two years and Similac Advance with Added DHA & AA entered the market in January 2004. In the U.S., Parent's Choice with blend of LIPIDS, Good Start Supreme DHA & AA, and Enfamil Lipil are available.

Second Stage Formulas

The category of second stage formulas has changed since the last review. There are three products designed for the older infant receiving some solid foods. Enfalac Next Step and Nestle's Follow-Up formulas are designed for infants over six months of age. Similac 2 Advance (released in January 2004) is intended for the 9 – 24 month old infant. It has added AA and DHA. In comparing the proportions of fat, carbohydrate and protein, the differences between the second stage formulas and the regular products, are less distinct. The main difference is the amount of calcium and phosphorus that is added to the second stage products. The

The main difference is the amount of calcium and phosphorus that is added to the second stage products.

Adequate Intake (AI) level for calcium increases during the latter part of the first year from 210 mg/day for the first six months to 270 mg/day for the second six. Regular formula contains 49 –57 mg/100 mL reconstituted. Similac Advance Step 2 and Enfalac

Next Step (Enfamil Next Step Lipil) products have a 50% increase in calcium and phosphorus levels. Follow-up has twice as much calcium and phosphorus as Good Start formula.

Value-Priced Products

Three products are available to parents at a significant cost advantage compared to name brands. Unilac is a Canadian company that offers an iron-fortified powdered formula through a variety of retail outlets including a chain supermarket, Zellers. Parent's Choice and President's Choice are sold in Wal-Mart and Superstore (Loblaws outlets), respectively. All products meet the requirements of Health Canada and the Food and Drug Administration. Comparison of the nutritional analysis of the different products does not reflect any major differences in the proportions of fat, carbohydrate and protein and in the sources of protein and carbohydrates. There are some differences in the whey:casein ratios. However, research is lacking to show any nutritional advantage of one over the other. The sources of fat are similar but there are certain products that contain palm olein. The cost differences between the store brands and the name brands with added fatty acids is very significant – up to two or three times the cost in some centres.

Summary

Breastfeeding is strongly encouraged as providing the safest, most nutritionally appropriate form of feeding for infants. "Human milk is alive and has functional components that have a role beyond simply the provision of essential nutrients. This includes anti-viral, antibacterial factors and enzymes"¹². If breastfeeding is not possible, infant formulas are the best alternatives.

References

1. Canadian Pediatric Society. Meeting the iron needs of infants and young children: An update. *CMAJ* 144:1451-1453, 1991.
2. Committee on Nutrition. American Academy of Pediatrics. Iron fortification of infant formulas. *Pediatrics* 104:119-123, 1999.
3. Ross Pediatrics. Personal communication. 2004
4. Smith, AM, Picciano, MF, Milner JA. Selenium intakes and status of human milk and formula fed infants. *Am J Clin Nutr* 35:521-6, 1982.
5. Pickering, LK, Granoff, DM, Erickson, JR et al. Modulation of the immune system by human milk and infant formula containing nucleotides. *Pediatrics* 101: 242-9, 1998.
6. Nelson, SE, Frantz JA, Ziegler, EE. Absorption of fat and calcium by infants fed a milk-based formula containing palm olein. *J Am Coll Nutr* 17 (4): 327-332, 1998.
7. Fraser Valley Health Region. Compendium of Breast Milk Substitutes. January 2002. www.bcouver.ca/files/forms/library/BREAST-1.pdf
8. Birch, EE, Hoffman, DR, Uauy, R., Birch, DG, Prestidge, C. Visual acuity and the essentiality of docosahexaenoic acid and arachidonic acid in the diet of term infants. *Ped Res* 44(2): 201-208, 1998.
9. Birch, EE, Garfield, S, Hoffman, DR, Uauy, R., Birch, DG. A randomized controlled trial of early dietary supply of long-chain polyunsaturated fatty acids and mental development in term infants. *Dev Med & Child Neurol* 42: 174-181, 2000.
10. Carver, JD. Advances in nutritional modification of infant formulas. *Am J Clin Nutr* 77(suppl): 1550s – 15504s, 2003.
11. SanGiovanni, JB, Berkey CS, Dwyer, JT, Colditz, GA. Dietary essential fatty acids, long-chain polyunsaturated fatty acids, and visual resolution acuity in healthy full term infants: a systematic review. *Early Hum Dev* 57:165-188, 2000.
12. Friel, JK. Human milk and infant formula. Nutritional content and health benefits. In: *Beverages in Nutrition and Health*. Wilson, T, Temple, NJ (eds). Humana Press Inc., Totowa, NJ pp. 235 – 246 in press.



Opinions expressed In-Touch are those of the authors and do not necessarily reflect the views of the HINI or the H.J. Heinz Company.

Material from In-Touch may be reproduced without written permission provided the source is acknowledged. Correspondence is welcome. Please write to: Heinz Baby Foods, H.J. Heinz Company of Canada, 5700 Yonge Street, Suite 2100, Toronto Ontario M2M 4K6.

If you are not on our mailing list...

Complimentary copies of In-Touch are available to health care professionals by writing us at the address indicated.

Have you moved? If your address has changed, please forward your new address, and if possible a copy of the old label to: Heinz Baby Foods, H.J. Heinz Company of Canada, 5700 Yonge Street, Suite 2100, Toronto, Ontario M2M 4K6



Printed on recycled paper

Please post or photocopy the reverse side for your patients.

INFANT FORMULA PREPARATION GUIDELINES

Both cow's milk and soy formulas are available in powder, liquid concentrate, and ready-to-feed forms.

STERILIZING

For infants under four months of age, sterilize bottles, nipples, tongs, lids, can opener, measuring cup, spoons and mixing jug. Sterilize by placing in a pan of boiling water for 5 minutes. Let cool and remove with sterilized tongs.

MIXING

Concentrate or powder forms:

1. Always wash hands before preparing infant formula.
2. Heat water until it reaches a rolling boil, continue to boil for 2 minutes, then let it cool (Bottled water should also be boiled and cooled). Boiled water can be stored for 2-3 days in the fridge.
3. Use the exact amounts of water recommended on the label to reconstitute powdered formula. For concentrated liquid formula, mix equal parts with water.
4. Refrigerate any opened cans of liquid concentrate. Use it within the time specified on the can.
5. Once powdered formula is mixed with water, refrigerate it and use within 24 hours.

Ready-to-feed formulas:

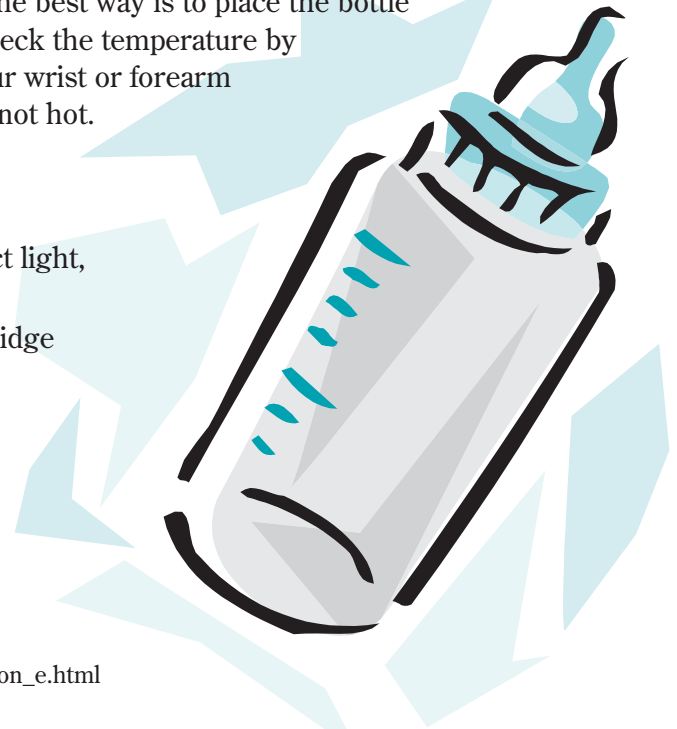
1. Always wash hands before preparing infant formula.
2. Shake the can well before opening. Clean the top of the can, open and pour into sterile bottle.
3. Refrigerate opened cans of ready-to-feed formulas and use within 24-48 hours.

HEATING

Warming formula before feeding is not necessary, but most infants prefer formula at least at room temperature. If you want to heat formula, the best way is to place the bottle in a pot of water and warm the pot on the stove. Check the temperature by testing a couple drops of the heated formula on your wrist or forearm before giving it to your infant. It should feel warm, not hot.

STORING

- Store unopened cans away from heat and direct light, in a dry place.
- Prepared infant formula can be stored in the fridge for 24 – 48 hours.
- Don't leave formula at room temperature for more than one hour.
- Do not freeze.
- Discard outdated infant formula.



Sources: www.hc-sc.gc.ca/dca-dea/publications/infant-nutrition_e.html
www.gov.mb.ca/health/nutrition/pubs/milkfo.pdf