

Sanford Medical Center

Aunt Cathy's Guide to:

Choosing Appropriate Infant Milks and Formulas



Aunt Cathy

Cathy Breedon PhD, RD, CSP, FADA
Prenatal/Pediatric Nutrition Specialist
Clinical Nutrition Specialist
Sanford Medical Center, Dept. of Pediatrics
and Clinical Associate Professor of Pediatrics
UND School of Medicine, Fargo, ND

Part 2: Commercial Formulas

Note: Formula companies regularly change the formula features and even the names. This paper was written February 2011 and may already be out of date in terms of specific brand details. ☹
Links to the websites of the companies are provided at the end of this section.

Which commercial formulas are used most often for healthy babies?

Most babies are fed **"standard" formulas that use cow's milk as a base**. The products have been adjusted to be as much as possible like human milk, although it is clear that many of the qualities of human milk cannot ever be duplicated. For example, many of the immunologic properties of human milk are "live cells," and even if they were present in cow's milk they would be destroyed by commercial processing.

Most babies will do well on any of the commercial standard formulas. There are few major differences among the brands because the Infant Formula Act makes it necessary for all products to conform to specific standards. However, there are some minor differences among them (within the overall guidelines) and occasionally a baby may do better on one product over another for a variety of reasons

Traditionally, infant formulas were designed to meet the needs of infants to age one. Recently there has been a trend to expand the age-range of the babies fed formula by developing products designed for the first six months, which are followed by a product designed for babies 6 months to age two. There are several different approaches, and there is no nutritional problem with doing this.

In terms of science, if these products remain the primary beverage of a toddler there will likely be an advantage in terms of reliably obtaining certain nutrients not provided by milk in at least small amounts. Babies' food intake would generally not be classified as "reliably well balanced" regardless whether the parent or the baby makes the choices, so these products can have a place, especially for the very picky baby with a limited range of foods. The bigger issue is the expense involved. This label change does essentially double the market for pediatric formula makers, however, so promotion of these products will likely increase.

Protein:

One difference among milk-based formulas is in the **proportion of casein milk protein to whey milk protein**. Cow's milk protein is 82% casein to 18% whey. Human milk has been reported to be about 40% casein to 60% whey (although estimations vary). In the belief that altering this ratio may improve digestibility, the standard formulas Enfamil and Similac [Mead Johnson and Abbott, respectively] been adjusted to have a casein:whey ratio near 40:60. However, the protein in "Similac Sensitive" is all casein.

Enfamil's "Gentlease" has a 40:60 casein: whey ratio, but then hydrolyzes the protein (partially breaks the protein into very small bits.) Gerber's "Good Start Gentle Plus" has 100% whey protein that has also been hydrolyzed to a smaller molecular size. It is intended to be easy to digest, but they do not claim that the particle size is small enough for it to be used for milk-allergic babies. See more in the discussion of allergy later.

In any case, any whey in all of these products is still cow's milk whey (primarily lactoglobulin,) and different in amino acid content from human milk whey, (primarily lactalbumin,) so a clear advantage/disadvantage of a particular casein:whey ratio has not been established for healthy, term infants. For example, the intact (unhydrolyzed) whey fraction may be the more allergenic of the two major types of cow's milk protein in some circumstances, so it is unclear that increasing its proportion in formula is automatically beneficial.

Some research suggests that the amino acid pattern in the whey fraction may actually be of higher biological value for humans, although this is an issue only in certain clinical applications and among athletes consuming (usually unnecessarily) expensive sports protein powders. This is not of importance in the feeding of healthy babies who are receiving standard amounts of calories and protein. Casein and whey are both classified as "High Biologic Value" proteins, and both can equally support appropriate infant growth.

There does appear to be an advantage to using whey-adjusted products for **premature** infants, whose immature systems are less able to cope with large amounts of casein. In the past, for some of these babies, a high casein content (e.g. 82%) which in the (now pretty distant) past was associated with an increased risk of problems with acidosis and with the formation of lact bezoars. For this reason, all formulas developed for use with premature babies are whey adjusted products.

For "normal infants," in actual practice, an individual baby may do better with one form or the other, so it might be worth a try to switch formulas if there appear to be digestive problems. For example, all-casein may decrease some infants' tendency to spit up excessively. The hydrolyzed products may help a baby who is troubled by constipation. These issues will be discussed later.

Traditional approaches to dealing with constipation have included inappropriately removing an essential nutrient like iron, or adding a lot of simple sugars like corn syrup or giving medications that impair absorption of nutrients like mineral oil. Compared with the nutritional consequences of these treatments, a trial on one of these products is clearly a nutritionally superior method of managing constipation. WIC Programs may have policies limiting the ability to try non-contract formulas in this way, but the nutritionists will still want to know about these issues for problem solving.

Of course, one should first help the caretaker differentiate true constipation from simple failure to have a daily bowel movement. Anything up to “every three days” can be a normal pattern as long as stools are soft. The misunderstanding about what is in fact true constipation accounts for quite a lot of waste of time and resources for WIC offices, physicians, and other health professionals.

Many parents and grandparents have been taught by health professionals in the past that it was critical for a baby to have a daily bowel movement. One of my books from the 1940s says that failure to assure a daily bowel movement put the infant’s mental health at stake. No wonder some people are overly focused on this end of the baby!

Carbohydrate

Most milk-based formulas contain lactose as the primary carbohydrate, which is the same as is found in human milk. Any milk formula that is identified as lactose –free will feature a cow's milk base (100% casein) with the **milk sugar (lactose)** removed and replaced by **glucose polymers (starch.)** Similac Sensitive is this type.

The Enfamil Gentlease product has a 40% casein:60% whey ratio with the protein hydrolyzed. It is not completely lactose free but it is described as having only a fourth as much lactose as regular Enfamil. They promote it for babies who “show transient intolerance to lactose but who are not lactose intolerant.”

These formulas may be useful for lactose intolerant infants for whom soy formula had been almost the only option in the past, especially when there are concerns about soy, or the higher quality protein source or slightly better calcium absorption seen with cow's milk formulas is an issue for a particular baby.

True lactose intolerance of more than a transient nature is quite uncommon in healthy infants, however. As described earlier, even among ethnic groups with a high incidence of lactose intolerance among adults, the primary carbohydrate in mother’s milk around the world is lactose. It is likely that much of the “improvement” sometimes described when the formula is changed to one of these products is less due to the lactose in the name and more to the removal of the whey. There is no evidence that babies who are fed a lactose-free formula later “have trouble” making lactose. This is an often-voiced theoretical concern of some health professionals. Consider the many babies who “graduate” from an entire first year of lactose-free formula (including soy formulas) and then easily make the switch to regular milk.

[See “Aunt Cathy’s PMS System of Baby Formula Decision-Making” for an example of formula choice problem-solving that uses the lactose issue as an example.]

Non-protein Nitrogen (Nucleosides and Nucleotides)

Human milk contains a significant amount of “non-protein nitrogen”, much of it in the form of **nucleotides and/or nucleosides**. . . the material used to make DNA and RNA. There is evidence and speculation that nucleotides in human milk especially promote the development of the intestinal tract and the immune system. These are tissues with the fastest “turn-over” time, and the need for nucleic acids for replacing these tissues may be greater than what can be easily provided by endogenous production by an immature liver.

For this reason, and because of the teleologic evidence of the presence of these substances in human milk, many commercial formulas have added them to at least some of their products. Large studies are in progress to determine if this addition brings about a measurable change in susceptibility to infection, etc. The amount and forms of these substances varies with different brands. In general, adding nucleosides/nucleotides appears to be advantageous and not harmful.

“Pre- and Pro-biotics”

Another area of research into formula manipulations that may provide immune benefits to formula-fed babies is the addition of “**friendly**” **micro-organisms** (now commonly referred to as “**Probiotics**”) to a formula. For example, over ten years ago it was shown that supplementing infant formula with *Bifidobacterium bifidum* and *Streptococcus thermophilus* was found to reduce the incidence of acute diarrhea and rotavirus shedding. Rotavirus is a common plague of day care facilities, clinics and WIC offices, and many health-care dollars are spent in treating it. The “decreased shedding” aspect has the potential to significantly curtail the spread of diarrheal disease to others. [*Am J Gastroenterol* 2000;95(1 Suppl)]

Research has continued, and more recently, Nestle (now Gerber) introduced a trademark fiber they call “Probio.” It is intended to promote the growth of “friendly” intestinal flora and designed for children after age one. In the spring of 2007 they introduced a new infant formula with live/active cultures of the non-pathogenic “probiotic” organism “*Bifidobacteria lactis*” – often abbreviated as “*B. lactis*.” The product is currently called Nestle Good Start Protect Plus™. It is regarded as a standard or routine infant formula. It is made with 100% whey, partially hydrolyzed, and with DHA & ARA, two polyunsaturated fats that are discussed below.

Pre-biotic refers to substances in the formula that promote the growth of friendly micro-organisms (**Pro-biotics**) Abbot’s new Similac Advance EarlyShield™ is an example of a product that features both pre- and pro- biotics, DHA and ARA, antioxidants and nucleotides. Mead Johnson’s new Enfamil® PREMIUM™ with Triple Health Guard™ has these things but it has pre-biotics but no pro-biotics. There are now many store-brands featuring one or more of these components as well.

These changes in product design and the formula names the manufacturers assign to each version continue at a rapid pace. Papers like this one become outdated virtually overnight because of name changes alone. So instead of comparing the fine points of these, it will have to suffice to describe what the nucleotides, DHA/ARA, Pre- and Pro-biotics are generally about. A simple chart can sort out the specifics.

Fat Content

The standard formulas also adjust the **fats** by controlling the **types and proportions of saturated, monounsaturated, and polyunsaturated fats, and the families of polyunsaturated fatty acids (omega-3 vs omega-6)**. There has been a trend toward trying to produce a lipid profile in infants closer to that seen with the consumption of human milk, recognizing that the fatty acid pattern of mother's milk itself will vary with her intake and with her ability to produce certain 20 and 22 carbon fatty acids from the essential fatty acid substrates as described earlier.

New insights about the role of various forms of fat in the production of prostaglandins, in immune function, in brain development, in micronutrient absorption, in constipation problems, and in long-term cardiovascular health have prompted several companies to focus on this aspect of the formula. Enfamil, Gerber, Similac, and some store brands all have adjusted lipid profiles of one or more of their products in the recent past, and then they all changed their formula names to reflect this. Initially, they produced version with and without the DHA and ARA fats.

Now, the companies are dropping the name parts that distinguished between the two versions of their products (respectively, words like "Lipil, "with DHA and ARA" and "Advance." As yet, not all the formulas in a company's product line have been altered in this way, although all are working in that direction. For example, the metabolic formulas do not yet include DHAS and ARA. These additions are welcome. However, there are still areas in which the lipid pattern of formulas differs significantly from human milk, and from each other.

For example, as described earlier, human milk has significant amounts of **cholesterol** and varying amounts and ratios of **long chain omega-3 fatty acids (eicosapentaenoic acid -- EPA, and docosahexaenoic acid -- DHA) and long chain omega-6 fatty acid (arachidonic acid—ARA.)** These fats appear to have many important roles in infant development, especially of the brain and retina, whereas cholesterol is a key component of myelin and cell membranes.

What is unclear at present is whether all or even most infants (especially sick or premature infants) are able to produce appropriate amounts of these substances from the vegetable oil precursors traditionally provided in formula (linoleic and alpha-linolenic acid.) The enzyme systems that accomplish these transformations in more mature people may not be adequately developed in infants. The ability of many adults to do this is also now known to be sometimes marginal, and may be especially so during pregnancy.

Providing the **preformed EPA and DHA** in particular may also be very important in pregnancy; for example, low consumption of fish (the primary dietary source) is associated with increased risk of preterm birth, and as mentioned earlier, providing fish oil in pregnancy may decrease allergy problems in infants. ARA is less likely to be similarly low in the American maternal diet as it is provided in meats. This may become a research question in regard to vegetarian mothers, however.

Until 2001, none of the formulas in the U.S. had altered their composition to provide preformed ARA, EPA and DHA comparable to human milk. In part this was because it takes a long time to establish the safety and appropriateness of any changes in infant formulas, and such

changes would involve government approval. In Europe and Asia, ARA and DHA had been added for years to at least some formulas, and now they are also being added in America.

At this time EPA, (the 20-carbon omega-3 fat) is NOT added to infant formulas. During the formula transition period when ARA and DHA were first approved for use in American formulas (~2001) it was not clear if EPA would be a beneficial addition. This issue has still not been thoroughly evaluated, and so it is still not added.

The ARA and DHA added to infant formula are not derived from fish or animal fat but from microorganisms. This source is FDA approved. The products for premature infants have these fatty acids added as well, as have their respective soy and lactose-free milk-based formulas. There are some differences in the relative amounts of DHA that are currently added to the standard formulas. DHA and ARA are gradually being added to other infant formulas in each company's product line because the research has continued to see positive outcomes in terms of some measures of infant development.

Percent of Fat Provided as DHA and ARA*

(*True at one time and likely to change one way or another at any given moment. Check the label)

	Gerber Good Start with DHA and ARA	Enfamil Lipil	Similac Advance
DHA 22 carbon omega-3	0.29	0.32	0.15
ARA 20 carbon omega-6	0.59	0.64	0.40

Cholesterol

As described earlier, another lipid-related difference between formula and human milk is that none of the formulas contain any cholesterol. This is reportedly because of difficulties with it not staying well-blended in the product. As cholesterol has many critical roles in infant development (such as myelin production, cell membrane stability, and production of vitamin D, steroid hormones and bile acids) its absence in commercial infant formulas is not necessarily ideal. Since human milk is high in cholesterol and it is a precursor to so many important substances, there is some concern about the ability of all babies (especially sick or premature infants) to manufacture sufficient quantities to meet their needs optimally.

Similac no longer contains a form of fat used in some other formulas called palm olein, and studies by Ziegler *et al.* suggested that this change improved absorption of the fat and of minerals such as calcium which can be lost when fat is poorly absorbed. Along with the casein: whey ratio adjustment, this fat blend change may also account for the reported decreased problem with constipation compared with their older formulation.

Iron in Formulas

A bit of history:

For years, most standard formulas came in two types: with and without **iron fortification** at the currently recommended level. Iron fortification is recommended by the American Academy of Pediatrics (AAP), so babies given low-iron formula usually also receive supplemental iron, at least they were advised to by about 2 months of age. Those not given iron in some form are at greater risk of using up iron stores, especially if iron-rich foods are not used. It was also common for people to stop giving the iron drops to the baby because “she doesn’t like it” or because “it stains his clothes,” so there was always a concern about the baby actually getting the prescribed iron when administered this way.

To help with the staining issue, I used to advise folks to give the drops when the baby was in the tub and then just hose him down afterward. A discussion of the contribution of the “tongue extrusion reflex” was also helpful in determining when she truly didn’t like it or was just reflexively pushing it out. [The great “Iron Drop Issue” is now resolved, but these suggestions are still useful with any vitamin or medication dros.]

These low-iron formula products had a warning label that they were "deficient in iron" and should be used only with a close look at baby's total nutrition plan. Unfortunately, many health professionals mistakenly believed that "low iron" simply means that it provides "adequate-but-not-excessive" iron, and many babies did not receive any iron supplementation, and there was a resurgence of anemia.

Most "with iron" products contained 10-12 mg of iron per liter; some "low iron" products contained only 1-1.5 mg/L; others up to 4.7. Because of this confusion about iron labeling, and the increase in the incidence of anemia in infants, the AAP was prompted to issue a statement that “there is no place in normal infant feeding for low-iron formula.”

In 2007, in order to prevent this kind of confusion and the possibility of babies receiving inadequate iron, formula companies began to discontinue making low-iron versions of their standard formulas. However, the other products are still described as “with Iron” for some reason.

As described earlier, the other big problem that used to be blamed on the iron drops or iron fortification of formula was CONSTIPATION! **Although it has been shown in many studies that iron fortification of formula did not cause constipation, belief that it did was a major reason why iron supplementation did not occur.** It is interesting to note that one of the newer formulas that came out (God Start) worked very well in resolving constipation problems, and it only came "with iron."

However, the belief that iron causes constipation is deeply ingrained in the public. **As described earlier, it is somewhat disconcerting to realize that some people apparently would choose to remove an essential nutrient from their child’s diet in order to form “the perfect stool”!**

What about Soy Formulas?

If a baby does not do well on the standard formulas, perhaps because of difficulty digesting milk sugar (**lactose intolerance**) or because of **allergy to cow's milk proteins**, the next choice has traditionally been a soy-based product. The use of soy formula for allergic babies is discussed in the "Allergy" section below. For lactose intolerance, either soy or the lactose-free cow's milk based formulas can be used.

As noted, true lactose intolerance is rare in infants, even among ethnic groups with a high incidence of lactose intolerance in adulthood. All human milk is naturally high in lactose, and nearly all babies have the digestive enzymes necessary to digest it and absorb it. Sometimes a baby may be temporarily lactose intolerant due to gastroenteritis or other bowel conditions. Serious malnutrition can also cause temporary lactose intolerance.

Although babies are often switched to a lactose-free product when they have gastroenteritis or diarrhea of any etiology, it is not at all clear that this is necessary. Consider that we advise breastfeeding mothers to continue nursing if the baby is sick, and this product only comes with lactose.

Except in extreme cases of bowel damage or "starvation stools" (often caused by malnutrition resulting from inappropriate withholding of adequate nutrition in an attempt to treat diarrhea,) studies indicate that most infants recover well from occasional diarrhea when one simply continues to feed them their regular breastmilk or formula in the normal way. Although not a harmful practice, many health professionals switch these infants to a soy product because of pressure from the parents to "do something" to treat the diarrhea, rather than because of clear benefit. In general, actual loss of lactase enzyme production is not a problem with short-term diarrhea episodes that infants may experience.

One comparison of an experimental soy-based formula with the carbohydrate as lactose versus sucrose did support the idea of a small benefit of providing a non-lactose carbohydrate formula during diarrheal illness (*Arch Pediatr Adolesc Med.* 1999.) Whether the magnitude of benefit is worth the effort of switching formulas is unclear. And, although breast milk is high in lactose, continued nursing is clearly recommended for many reasons instead of switching to a lactose-free or any other formula.

One modified soy product is promoted primarily as a treatment for diarrhea: "Isomil DF" (DF= "Diarrhea Formula") is now called "Similac Expert Care for Diarrhea." It is lactose free and in addition contains dietary soy fiber. This product appears to reduce the duration of watery stools somewhat, but not the total volume of diarrheal stools (*Pediatrics* 92,'93). As it is often considerably more expensive than standard or regular soy formulas, the overall benefit in diarrhea management is not that clear, and since the place of fiber per se in infant diets is also unclear, it remains to be seen if this product will fill a crucial niche. The cost may be prohibitive as well.

On the other hand, use of this product is far superior to feeding only electrolyte replacement solutions for more than 24 hours. Enfamil's Enfalyte, Gerber's LiquiLytes and Abbott's Pedialyte are examples of this kind of product. They are intended for short-term use only, and they are not complete nutrition products. They have no protein or fat, only a few

calories as carbohydrate, and some electrolytes to replace those lost with diarrhea. However, there have been cases of babies fed only these solutions far too long ... again, “until they can form the perfect stool.” And of course, they never do. The intestinal tract has nothing to work with to recover normal function. This is one cause of “starvation stools” in the developed world. In parts of the world it is usually due to combinations of malnutrition and dysentery.

A soy hydrolysate product was developed and it is now marketed as “Good Start Soy Plus.” It is designed for babies and children from 9-24 months. It is both lactose free and milk protein free, so for those who would benefit from a hydrolysate formula (for whatever reason), the new option of a completely dairy free hydrolysate product may be useful.

Soy in general:

Since soybeans naturally provide incomplete protein, (they are especially low in the essential amino acid methionine,) methionine is added to improve the **quality of the protein**. In addition, soy formulas have an **increased quantity of protein**, to make up for the somewhat decreased digestibility and absorption. Soy formula is often used by vegan families who prefer to provide no animal-based foods, or those with other strict dietary practices that makes using a milk-based formula more problematic (e.g. Jewish dietary laws prohibiting milk and meat at the same meal.)

It is common to try soy formulas if a baby does not do well on standard milk-based formula, but it has traditionally been assumed to be best not to keep the baby on the soy product if the switch did not lead to improvement. While a baby can certainly grow well on soy formulas, there is somewhat better absorption of calcium and certain other nutrients with cow's milk based standard formulas, so for now the standard cow's milk-based formulas are the formula choice of most physicians. Studies have noted normal bone mineralization using soy formulas, so this may be a less import issue than was previously thought.

However, with the interesting recent discoveries of potential benefits of soybean consumption for the general public (such as possible decreased risk of heart disease, cancer, osteoporosis and menopause discomfort,) this general preference may change. The jury is still out on whether soy is everything it is being promoted for in that regard.

Soy infant formulas are made from "soy protein isolate," though, and not from the whole soybean, so there is much work to be done to determine if the products as currently made provide any special benefits. Sometimes switching to a soy formula helps with constipation (and other times it seems to contribute to it.) However, since **all recognized soy infant formulas are fortified with iron**, a trial on soy is reasonable and does not jeopardize the child's nutrition, as some interventions can be as described earlier. If it does help a particular constipated baby, it is due to some other (non iron-related) aspect of the formula change (i.e. the form of protein, fat or carbohydrate.)

In spite of the possible benefits of soy consumption observed in adults, avoid home-made soy formulas, or so-called "soy milks" for infants, since there may be serious problems in nutritional adequacy with any do-it-yourself formula, especially if protein is incomplete. Unfortunately, I have seen a baby with permanent neurologic injury from having been fed an exclusive diet of this kind of home-made “formula.”

Because of the higher protein content but lower overall protein quality, it may be wise to think of the average .56 g protein/oz of soy formula as equivalent to the average .45 g protein/oz in cow's milk-based formula when intake levels provide protein at the lower end of the desirable range. Otherwise, there is the potential for the protein intake to appear to be marginally adequate, when its actual bioavailability may be less. When there is concern about a baby's ability to handle protein waste products (such as in renal or hepatic disease,) remember that there is more urea to excrete with soy products than with human milk or milk-based formulas because of the lower biological value of vegetable protein.

Soy formulas are not designed for use by premature infants; short term use may not be detrimental and soy formulas may be used in the usual way once the child has achieved "term baby" size and nutritional status. However, as will be discussed later, the special needs of preterm infants will not be met by these products designed for term babies.

Research into the properties of **soy phytoestrogens** on conditions such as menopause and osteoporosis has raised the issue of the effect (if any) of providing phytoestrogen-rich soybeans as the central component of an infant's diet. ["Phytoestrogens" means plant-based estrogen-like hormones.] There are concerns that the observed high serum levels of phytoestrogens in some babies using soy formula may have an untoward effect on hormonal development or other metabolic derangement. At present, the experts disagree on whether soy formulas are quite safe or whether they should be avoided.

As with earlier concerns raised about exposure to cow's milk protein formulas and a possible link to diabetes, it leaves health care professionals in a tough place: For bottle-fed babies, should we recommend milk-based or soy based formula as the first choice? Are they both equally safe? Is either or both unsafe? How large is the relative risk? Should we recommend a hypo-allergenic hydrolysate like Ross' Alimentum or Mead Johnson's Nutramigen (at much greater expense and less acceptance due to flavor and olfactory aspects)? How about a hydrolyzed-but-not-quite-hypoallergenic product like Gerber Good Start? The best answer, of course, is to encourage breast-feeding, but when that is not an option what should be done? Stay tuned . . .there is simply not enough research and consensus of expert opinion yet to make a recommendation. **Allergy-related issues will be addressed in the next few pages.**

Because soy formulas are lactose free they are also used by infants and children with the inborn metabolic error called "**galactosemia**". Although some galactose may be present in the product as a component of some small (3-5 unit) oligosaccharides (not as lactose or free galactose,) at present it appears that the carbohydrate in this form is not digested and therefore there is no free galactose absorbed. **It is critical that infants with this condition not be confused with those who are "lactose intolerant."** Lactose intolerance causes gas and diarrhea when lactose is consumed, but lactose consumption by the child with galactosemia causes mental retardation and other serious damage.

Using fermented dairy products (e.g. yogurt) or enzyme additives such as "Lact-Aid" or "Dairy Ease" to break down lactose in foods/beverages may help intestinal discomfort of lactose intolerance, but they **cannot make lactose safe for the child with galactosemia**. Because of trace amounts of lactose in the "lactose-free" milk-based formula described earlier, these products are not recommended by their manufacturers as the best choice for infants or children with

galactosemia. The new “reduced lactose” Enfamil Gentlease has much more than trace amounts of lactose (one fourth the amount in regular Enfamil,) so it is clearly not to be used for babies with galactosemia.

Are there any differences among the soy products?

The type of vegetable fats used vary somewhat, from a single-source fat to combinations of coconut, soy, and/or safflower oils. The fat blends are an area of considerable interest, and as with the standard formulas there has been recent reformulation of some soy formula products to achieve lipid profiles closer to that of human milk. As with the standard milk-based formulas, DHA and ARA are generally added, but EPA is not.

Standard and soy infant formulas provide 20 calories per oz.

Percent of calories from:	CHO	PRO	FAT
Desirable range (Fomon):	35 - 65	7 - 16	30 - 55
Standard formula (cow's milk based): (Enfamil Good Start, Parent's Choice, Similac, etc.)	41 - 43	9 - 11	48 - 50
Soy formulas: (Prosobee. Good Start Soy, Parent's Choice Soy, Isomil,)	39 - 45	11 - 13	45 - 49

Soy products also vary in the type of carbohydrate used. Isomil uses corn syrup and sucrose, but there is also a product called Isomil SF, which is sucrose-free and contains only the corn syrup. Enfamil Prosobee uses corn syrup alone. There are certain rare conditions in which there would be an important reason for choosing one carbohydrate source over another (e.g. hereditary sucrase-isomaltase deficiency,) or other special needs.

However, the most common reasons for using soy formula (milk protein sensitivity or lactose intolerance) do not require any particular carbohydrate or combination to be used. Some babies may prefer the flavor of one product over another. In addition, some physicians or dietitians may prefer, and so recommend, one product over another, usually as a result of familiarity with a particular product. And, of course, WIC health professionals will have one product as their “contract formula.”

Formula Choices for Babies with Allergies

True allergy is much less common than commonly believed to be an allergy
Immunoglobulin E (IgE) must be involved. Most formula intolerances are not due to allergy, although people commonly describe almost any formula intolerance as an allergic reaction. Some infants are genetically at greater risk of developing allergy than average. For most babies at risk of allergy, human milk is best because of factors in it which decrease risk of allergy development at the level of the infant's intestine; there may also be less exposure to antigens than would occur with any intact cow's milk or soy protein.

It is true, however, that intact proteins (including cow's milk proteins) have been found to be present in the milk of some women. In such cases, it may be helpful to have the nursing mother refrain from eating the protein(s) to which the child reacts (with guidance from the dietitian to assure that her diet continues to be complete in spite of any limitations imposed.)

There is evidence that even the mother's diet during pregnancy may be a factor in allergy development of certain infants, contributing to allergy risk, and as described earlier, possibly helpful in decreasing risk of allergy development. Interestingly, some of the foods eaten during pregnancy associated with LESS risk of an infant developing allergy include fish! Vitamin D adequacy may also be a factor. It is also unclear whether breastfeeding or using special hypoallergenic formulas prevents or merely delays the development of allergies in children with a strong genetic propensity to develop allergies.

For some allergic infants a hypoallergenic "protein hydrolysate" product may be necessary. An allergic response is based on recognition of the SHAPE of the protein. If the protein is snipped into such small pieces that the body's immune system does not recognize them as any particular protein they will not result in an allergic response. Therefore, products with "hydrolyzed protein" ("Similac Alimentum", "Enfamil Nutramigen") should not cause an allergic response (although there have been isolated cases even with these. Nutramigen and Pregestimil are both made by the same company (Mead Johnson). The difference between them is in the fat blend. Both have the same hydrolyzed protein, but Pregestimil also has about half the fat provided as MCT oil. This has applications for babies with certain types of digestion and absorption problems.

Pregestimil is also somewhat more costly and harder to find, so if the baby's problem is related to allergy and not gastrointestinal issues, **Nutramigen** would be the first choice of the two if using Mead Johnson products. Abbott makes **Alimentum**, a single product designed for use with both allergy and gastrointestinal problems and it only comes with the MCT adjustment. There is no problem in providing MCT in the formula even if the problem being addressed is allergy only, however, so it is useful in both situations.

In rare cases a true elemental product made with synthetic amino acids (such as "EleCare," "Neocate," or "Vivonex Pediatric") or peptides ("Peptamen Jr.) may have to be used for an allergic child. However, usually children who need a truly elemental formula are those who have other gastrointestinal issues such as short bowel. Interestingly, the "FAS Free Amino Acid" elemental product is marked "Not hypoallergenic" on the label. "Good Start" and "Enfamil Gentlease" are only partially hydrolyzed and should not be regarded as truly hypoallergenic.

There may be a role for this type of product as a feeding for potentially allergic infants before cow's milk allergy has developed, however, since it was seen to result in fewer infants developing an allergic response than when fed formulas with intact protein. As "Good Start" and "Gentlease" are less expensive (plus better tasting and more readily available) than the more hydrolyzed products, they may be a good choice to use preventively. As noted earlier, there is now a soy hydrolysate available for babies and children from 9-24 months called "Good Start II Soy Plus." Nestle's recent (2007) addition of Bifidobacteria lactis to Good Start Supreme is also being described as contributing to decreased allergy risk or severity because of improved intestinal health.

Whether or not soy formula is the formula of choice for a child genetically at risk of serious allergy problems has been the focus of discussion in the medical literature. Although for some time it has been thought that soy protein is probably as allergenic as cow's milk (and therefore a poor first choice), it now appears that soy use in children who develop a cow's milk allergy is usually safe, and that earlier estimates of the prevalence of soy allergy may not have been accurate. As soy formulas are also less expensive and more widely available than hypoallergenic products, they are also a reasonable choice.

Formula Choices for Premature Babies:

Premature babies have very special nutritional needs because of 1) immature organ systems, which decrease tolerance of nutritional excesses and deficiencies, and 2) special growth needs related to the rate of growth and tissue development (e.g. bone mineralization) that occur during what is normally the third trimester of pregnancy. For this reason, formulas for prematures typically **have higher nutrient levels per fluid volume** (e.g., 24 kcal/oz instead of the standard 20; and higher levels of protein and minerals such as calcium, sodium, and phosphorus.)

The protein is cow's-milk-based, and all have a 60%:40% whey-to-casein ratio. All have modifications of carbohydrate (variable proportions of lactose and glucose polymers) and fat (all contain some MCT, but proportions vary by product, and all except the modular component products are now fortified with ARA and DHA.) The exact needs of prematures are quite variable, depending on such factors as size for gestational age and the presence of serious medical complications. Even without these complications, there is much that is not known about what is optimal nutrition for the "premie."

In the US, three formula companies make formulas for prematures: "Enfamil Premature Formula / EPF" (Mead Johnson) "Good Start Premature" and "Similac Special Care"). Mead Johnson and Abbott also make a **powdered** and liquid **products to add to human milk** ("Human Milk Fortifier") and Abbott also makes a liquid product to mix with human milk ("Similac Natural Care"). These fortifiers are designed to allow babies to receive the many benefits of human milk (digestibility, immune factors, etc.) while meeting the increased protein, vitamin, mineral and caloric density needs of premature infants. Good Start is an all-whey hydrolysate like their regular product.

The powder additive has the advantage of allowing more of the mother's milk to be utilized, which increases intake of the important immune and digestive benefits of human milk while providing the extra calories, protein and nutrients needed by premature infants. The liquid is easy to mix well, and may be most helpful when only a small amount of mother's milk is available for use. New issues about the safety of powdered fortifiers are discussed later.

Initially, none of these products was designed for use outside of hospitals, but now that discharge from the hospital is occurring earlier and at lower body weights because of insurance company reimbursement policies, formulas for babies born prematurely are now produced for home use. In the past, once an infant had reached about 2 kg weight, or otherwise considered to be ready for discharge, all of the formula companies recommended switching to a product designed for term babies. By this size, they were assumed to have accomplished their third trimester bone mineralization, so there was no longer thought to be a need for the increased calcium, sodium and phosphorus found in formulas for prematures.

However, research measuring bone density has shown that for many of these babies normal bone mineralization has not been achieved by hospital discharge, even among some who had achieved weights above 2 kg. For a month or more post discharge from the hospital, there may be a continued need for the special "premie" formula especially for babies who were very premature, or who were very sick. As follow-up bone density measures are rarely available, monitoring alkaline phosphatase levels may help determine when the special product is no longer needed. This is also impractical in many settings.

Not all babies will require the continued use of the specialized products for premature infants. If higher calorie needs continue because of fluid restrictions or hypermetabolic conditions (e.g. bronchopulmonary dysplasia), modifications of standard formulas for term infants are often much more appropriate than the products described above. They are also more readily available, since these premature products are very expensive and not always easy to obtain in rural areas. For example, a **24 Kcal/oz (non-premature) infant formula can be made by using less water in diluting liquid formula concentrate (9 oz water to 13 oz can) or powdered formula (3 scoops powder to make 5 oz formula)**. All the nutrients remain in the same relative amounts ... only the volume differs.

The premature products above come only in a ready-to-feed form. "Similac NeoSure" now called "Expert Care" and "Enfamil EnfaCare have been designed for **home use** for those prematures who have a continued need for extra nutrients. In general, they provide 22 kcal/oz mixed according to their "standard" recipe, but they can be prepared at whatever caloric density is appropriate by adjusting the proportions of water and formula powder. Prepared to 22 calories/oz, they are about halfway between a premature product and regular formula for most nutrients. Protein is at levels closer to the premature products described above.

They may be cheaper than other premature products, however, and (depending on stores) comparable in price to regular formula. They are being promoted as suitable for the entire first year of a premature infant's life (not just a few months post discharge), and the nutrient levels do fall within the guidelines of the Infant Formula Act for standard formulas, so continued use should do no harm. They come in a ready-to-feed 3 oz (EnfaCare) or 4 oz (NeoSure / Expert Care) bottle and in powder form. **For babies described as "osteopenic," or those who were very small or very sick premature infants, these products may not be ideal**, and the true hospital-type premature products may be recommened for at least a month or so after discharge to optimize growth.

As with the standard formulas, the very long-chain fatty acids (ARA and DHA) were added to formulas for premature infants in the US. Most experts agree that if there were a group most likely to be unable to accomplish the production of very long chain fats from the linoleic and linolenic acid precursors, it would be premature infants. For this reason, all these products have ARA and DHA added. None of these formulas has pre-formed EPA at this time.

Another newer issue in the care of premature or immune-compromised infants in hospitals is a concern about possible risk of *Enterobacter sakazakii* infection when powdered formulas are prepared. This includes the powdered human milk fortifier products. **The FDA has recommended that powdered infant formulas not be used in neonatal intensive care settings unless there is no alternative available.**

The problem is that the powder itself is not sterile. For this reason, even very careful handling of the formula during preparation does not result in a sterile product. If powdered products must be used, special aseptic preparation techniques have been recommended. This development occurred in 2002 and it (continues to) result in changes in infant formula packaging and in their preparation in hospital settings.

This web-site has details and specific recommendations:

www.fda.gov/Food/FoodSafety/ProductSpecificInformation/InfantFormula/Alerts/SafetyInformation/ucm111299.htm.

Although this issue is directed at hospital care, it is a good reminder of the importance of addressing appropriate formula preparation techniques with caretakers of all infants. In response to the concerns about powders in the NICU, new formulations like a new **30 kcal/oz Special Care liquid**, which can be diluted with sterile water when there is a need for the caloric density of a premie formula that provides more than the 24 kcal/oz provided by the regular Special Care. Whenever possible ready-to-feed versions of the ICN formulas at various concentrations are now used instead of mixing formula powders.

What are all those other formula products that are sometimes used?

A large number of products have been specially formulated to meet the unusual nutritional needs of children with **inborn errors of metabolism**, with digestive diseases, or with severe limits on the amount of sodium or minerals that they can tolerate. Because these products are made to very careful specifications and require complicated production techniques, they are often quite expensive and may not be easy to obtain on short notice. **Because the market is so small, the companies that manufacture them often do so at a financial loss as a public service.** These products are discussed in a separate section of this paper.

What about all those formula product changes?

Luckily for us all, it is now easy to access plenty of detail about specific products on line. As they change every five minutes, this is going to be a much more up-to-date resource than this paper. I just google them whenever a question comes up about the latest name-change, etc. For example, here are some websites that have all the information:

Abbott [Similac products]

<http://abbottnutrition.com/Products/Nutritional-Products.aspx>

Mead Johnson [Enfamil Products]

[http://www.mjn.com/app/iwp/HCP/Content2.do?dm=mj&id=HCP_Home/Product_Information/Product_Descriptions&iwpst=B2C&ls=0&csred=1&r=3437784865\)](http://www.mjn.com/app/iwp/HCP/Content2.do?dm=mj&id=HCP_Home/Product_Information/Product_Descriptions&iwpst=B2C&ls=0&csred=1&r=3437784865)

Gerber [Good Start Products]

www.medical.gerber.com/products/ProductCategory.aspx?CatId=20eb51b9-6bif-46b1-9cba-74b5b342c944