Kerry Health and Nutrition Institute.

Delivering Nutrition As Nature Intended

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Breast milk is undoubtedly the best option for infants, but there are times when a mother's milk is not available. In such cases, infant formula takes the lead and offers a nutrient-packed alternative. By Satya S Jonnalagadda, PhD, MBA, RD, Director of Nutrition, Kerry.

Proper nutrition is critical for the rapid growth and development that occurs during a child's first year of life. During infancy, nutrient requirements per kg of body weight are proportionally higher than at any other stage of life.

Human breast milk is the optimal food for infants because it has the perfect combination of nutrients needed for the infant's growth and development and major health organisations recommend exclusive breastfeeding for the first six months of life[1].

However, a mother's physical health, cultural, environmental, and socioeconomic factors influence a mother's decision and ability to initiate or continue breastfeeding. Hence, infant milk formula (0-6 months) and follow-on formula (more than six months) can play an important role in meeting the nutritional, growth and development demands of infancy.

Infant Formulas

When breast feeding is not an option or if breast milk is not available in adequate amounts, infant formula would be an appropriate alternative to meet the nutritional needs of the infants. A variety of infant and follow-on formulas are available for infants who are not breastfed or are partially breastfed. These include cow's milk or soy-based infant formulas, hypoallergenic infant formulas, and other formulas designed to meet the specific nutritional and dietary needs of infants. Such needs include lactose-free formulas and those that improve digestive tolerance and digestive health, help lower the risk of food allergies, improve immune health, and contribute to brain development and proper vision. These infant formulas are also developed to mimic the composition of breast milk.

Honza Soukup, Czech Republic

High-Growth Market

Infant and follow-on formula is one of the fastest growing food categories globally with double-digit growth rates[2]. This growth has been driven by rising demand from Asia Pacific, notably China, and also Indonesia, Philippines and Vietnam among others. Rising income translates into parents being able to buy formula for their infants—products that were unaffordable in previous generations.

With 29 percent of Chinese, 32 percent of Indonesian, 34 percent of Filipino and 17 percent of Vietnamese mothers reporting exclusively breastfeeding for the first six months, the market for infant and follow-on formulas shows tremendous potential.

However, with the WHO recommending exclusive breastfeeding up until the age of four to six months, stricter international regulations and marketing restrictions on infant formula will be expected. Despite this, the Asia Pacific market is likely to grow given low rates of breastfeeding, brand loyalty, recommendations from family and friends, as well as the large baby population.

Benefits of Breast Milk

Human breast milk is typically the sole source of nutrition required for the first six months of an infant's life. Its nutrient content has not only been used to establish dietary recommendations for infants, but is also used as the model system for developing infant formulas. Breast milk is unique in its physical structure and composition, with very specific types and concentrations of protein, fat, carbohydrate, vitamins and minerals, enzymes, hormones, growth factors, host resistance factors, inducers and modulators of the immune system and anti-inflammatory agents. This composition is important not only to promote infant growth and development, but also to support optimal health by protecting infants from food allergies, illnesses and to promote gut health. Diet has a major impact on the child development; hence, infant and follow-on formulas are formulated to be as similar as possible to the composition of breast milk from healthy, well-nourished women.

Human breast milk composition changes throughout lactation not only to meet the changing nutritional needs of the developing infant, but is also based on the dietary intake of the mother[3]. A key focus of the formulation of infant and growing up milk is to meet the changing nutritional needs of the developing infant.

Substituting Breast Milk

When breastfeeding is not possible, safe and suitable infant formula should be used. Over the past decade, infant formulas have been improved. An example would be the adaptation of the content and source of protein and the inclusion of long chain-polyunsaturated fatty acids.

Cow's milk based infant formulas are acceptable alternatives when breast milk is not available. However, cow's milk varies in composition compared to breast milk in terms of protein, fat, carbohydrates and minerals; hence it is important that nutritional composition is adjusted accordingly to meet the demands of the infant.

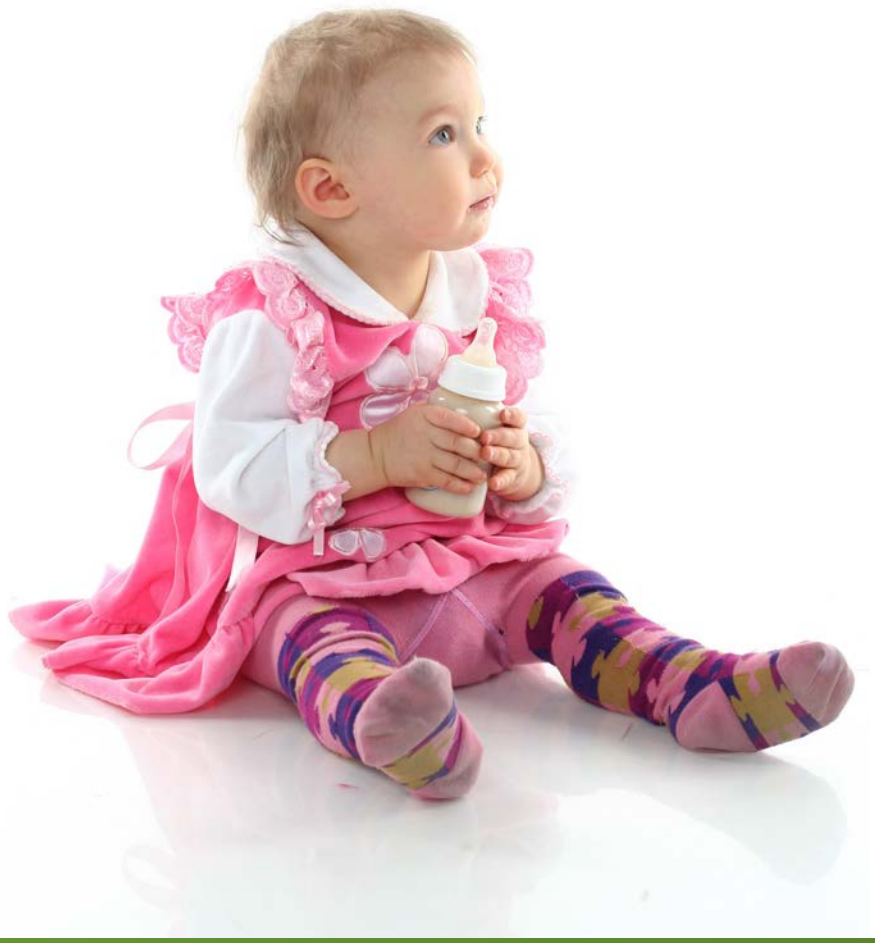
Given differences in digestibility and bioavailability between nutrients in breast milk and infant formula, it is important that the performance of both are similar, which may entail modifications of concentrations of nutrients as well as their sources. Additionally, given the bioactive composition of breast milk, alternative sources of such components need to be within the scope of the defined regulations for infant formula and ensure safety.

Customising Infant Formula

The International Expert Group (IEG) of the European Society of Pediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) has provided recommendations for the general nutrient composition of infant formula[4]. For instance, energy content should be between 60-70 kcal/100 mL to support healthy weight gain, with total fat in the range of 4.4 to 6 g/100 kcal, 1.8 to 3 g/100 kcal for cow's milk protein and 9 to 14g/100 kcal for total carbohydrates (predominantly from lactose). Glucose and fructose should not be added and if starch is added, it should be at levels up to 2 g/100 mL.

Infants have a lower protein intake with breast milk than with standard infant formula mainly because of the lower nutritive value and differences in amino acid profiles between human milk proteins and the casein and whey in cow's milk. Modifying the protein content and form in infant formulas has not only been shown to have an important role in lowering risk of common food allergies, such as cow's milk allergy, but also in promoting growth[5].

To address this need, a range of technologies has been established to support the development of infant and follow-on formulas that can make them as similar to breast milk composition as possible. One such development encompasses specific bovine milk casein fractions with nutritional and functional properties similar to human breast milk casein composition, which is more digestible than α-casein and caseinates.



Enhancing Digestive Health

The low digestibility of cow-milk protein along with heat treating of infant formula can limit the supply of essential amino acids and bioactive components to the infant. Selectively, partially and extensively hydrolysed proteins have been used in infant formulas to support easy digestion and absorption to meet the protein needs of infants. This aids in the successful dietary management of infantile colic and is effective in reducing the duration of crying[6]. These hydrolysed proteins have also been used to treat food allergies, specifically cow's milk allergies.

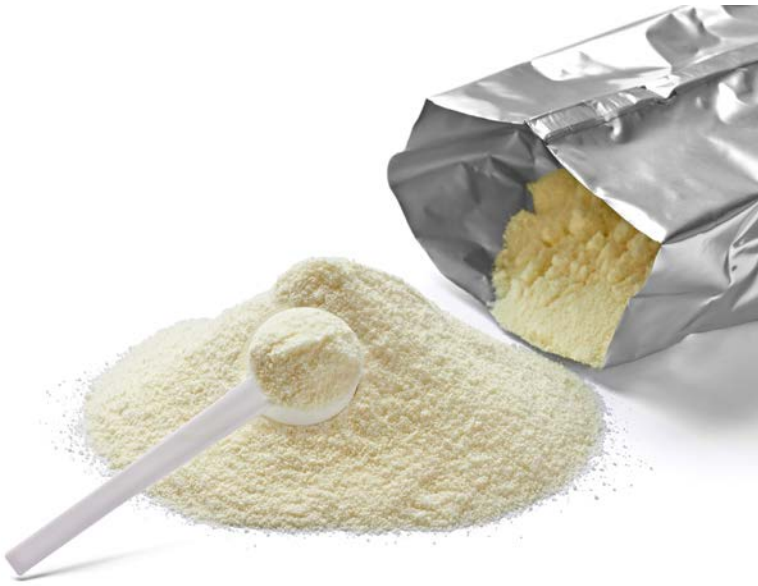
The infant's intestinal flora changes rapidly under the influence of diet and other environmental factors. For instance, bifidobacteria were observed to be the predominant microorganisms in breastfed infants. Its main growth-promoting factor is human milk oligosaccharides,which have a direct inhibitory effect on certain pathogenic microorganisms. Human milk oligosaccharides, namely, galacto-oligosacchardies (GOS), are complex sugars that function as selective growth substrates for specific beneficial bacterial in the gastrointestinal system[7].

Bovine milk contains analogues of these unique molecules, the majority of which are similar in structure to those found in human milk, but are present in lower concentrations. Whey streams have the potential to be commercially viable sources of complex oligosaccharides that have the structural resemblance and diversity of bioactive oligosaccharides in breast milk. The structural characteristics of milk-derived oligosaccharides are crucial to their ability to selectively enrich beneficial bacteria while inhibiting undesirable and pathogenic bacteria. Infant and follow-on formulas containing these specific oligosaccharides are important for the infant's digestive and immune health.

In addition to GOS, other oligosaccharides and polysaccharides, such as inulin, short- and long chain fructooligosaccharids (scFOS), gum acacia and combinations have been studied for their prebiotic effects in infants. Prebiotics have been shown to result in higher stool frequency and softer consistency than controls.

Evidence suggests that the interaction between intestinal microbiota and the gut plays an important role in postnatal development of immune system. Animal and infant feeding studies suggest that prebiotics, like the mixture of GOS/lcFOS, modulate the immune system and provide preventive effect with regard to the development of allergic disease, mainly mediated by modulation of the intestinal microbiota.

These prebiotics have also been observed to have a positive effect on calcium absorption and balance, and bone mineral density. The use of prebiotic mixtures in infant and follow-on formulas have been shown to be well tolerated, have bifidogenic effects, contribute to the development and strengthening of postnatal immune system and can be a safe tool for prevention of infections and allergies in infants.



A Consideration for Allergies

Approximately 60 percent of all allergies appear during the first year of life, with the most common being food allergies such as cow's milk allergy and atopic dermatitis. Between 5-15% of infants show symptoms suggestive of adverse reactions to cow's milk protein (CMP), while estimates of the prevalence of cow's milk protein allergy (CMPA) vary from 2-7.5 percent[8].

Among young Asian infants and children, egg and cow's milk allergy are the two most common food allergies with prevalence data comparable to western populations[9]. CMPA results from an immunological reaction to one or more milk proteins and is distinct from other adverse reactions to CMP such as lactose intolerance. CMPA may be immunoglobulin E (IgE) or non-IgE mediated. It is now well recognised that unmodified cow's milk derived proteins may lead to sensitisation in predisposed infants and are not recommended for those at high risk of allergic diseases. Various nutritional committees recommend hypoallergenic hydrolysed formula in non- or partially breastfed infants with an elevated allergic risk.

An optimal infant formula should contain sufficient allergens to induce oral tolerance, while having a sufficiently low allergen content to minimise sensitisation. Additionally, the formula should support the establishment of bifidogenic gut flora and most importantly, provide adequate nutrition to support infantile growth and development. Formulas made with hydrolysed proteins have been shown to address the needs of infants who suffer from dietary protein intolerance and reduce allergenicity[10]. In the treatment of allergic conditions, not only should the causal protein be completely excluded from the diet, but infant formulas that are based on extensively, selectively or partially hydrolysed protein should be selected based on the severity of the allergenicity. These formulas have been shown to induce oral tolerance without sensitisation[11]. Compared to cow's milk based formulations, studies with these hydrolysed formulas demonstrate reductions in short and long-term incidences of atopic diseases in high risk infants, with no negative effects on infant growth and overall improvements in health status.

The German Infant Nutritional Intervention Study observed a long-term allergy preventive effect of hydrolysed whey infant formulations on allergic manifestations and atopic eczema until six years of age. It was observed that the nutritional status and growth of infants fed extensively with hydrolysed whey formula were well within reference values. In 2011, the USFDA approved a qualified health claim for 100 percent whey-protein partially hydrolysed infant formula and reduced risk of atopic dermatitis[12].

Modulating Immunity

Newborns are more susceptible to infections, presumably because of their immature and inexperienced immune systems. The most common condition in infants are lower respiratory tract infections caused by viruses, especially respiratory syncytial virus. Breastfeeding is thought to provide protection against infections during infancy. Breastfed infants have an enhanced local humoral immune response, resulting in a lower prevalence of gastrointestinal and respiratory tract infections than in formula fed infants.

Immunoglobulins, lymphocytes, and lactoferrin, probiotics (Lactobacillus fermentum), which are all present in human milk, play a specific immunologic role. Infant and follow-on formulas containing these components can help modulate immune responses, lower risk of infections and help maintain infant health and wellbeing.

Brain and Retinal Health

Breastfed and formula fed infants differ in the amount and type of long-chain polyunsaturated fatty acids (LCPUFA) consumed. Supplementation of infant formulas with LCPUFA, arachidonic acid (ARA) and docosahexaenoic acid (DHA) have been shown to improve infants visual acuity up to 12 months of age and positively affect the speed of process involved in the information encoding, storage and retrieval from memory. Additionally, these LCPUFA can have an impact on growth and development and influence modifications of the immunological responses. Scientific organisations support the optional addition of LCPUFA in infant formulas; IEG specifies that DHA content should not exceed 0.5 percent of total fat intake while ARA content should be at least the same concentration as DHA. Eicosapentaenoic acid (EPA) content should also not exceed the DHA content.

Phospholipids are important building blocks for all cells in the body and play an important role in cell function. They are involved in a variety of physiological process in all tissues and cells, including digestion of lipids, components of lipids in the body and regeneration of cells, while those containing choline or serine are important in the functioning of the nervous system. Milk phospholipids in addition to phosphatidylcholine and phosphatidylserine also contain high levels of important structural and functional components, including ceramides, sphingolipids and gangliosides, which are important for the nervous system. Structural composition of the fats can also potentially impact infant bowel habits. The difference in the triacylcgyceol palmitate content of formula and breast milk can result in more calcium soap formation in formula fed infants and harder stools. Formulas containing triglycerides similar to those found in human milk (ie: palmitic acid esterified predominantly at the sn-2 position) were observed to have significantly higher absorption of fatty acids and calcium.

Advances in nutritional technologies have enabled the development of infant and follow-on formulas to meet the nutritional, growth and development needs of infancy. Nonetheless, a better understanding of the composition of breast milk and its impact on infant growth and development will support ongoing research and development to advance infant and follow-on formula composition to meet the demands of the growing infant.

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