

# Infant formulas explained

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## Introduction

Breast milk remains the best source of nourishment for infants, and as such all mothers should be encouraged to breastfeed. However, in exceptional circumstances breastfeeding may not be possible, and under such circumstances parents may seek a suitable alternative.

Infant formula is the only product recognised by the Codex Alimentarius Commission of the United Nations as a suitable breast-milk substitute. Worldwide various infant formulas are available and deciding on a suitable formulation may seem daunting. Understanding the basics behind the composition of formulas may facilitate this decision-making process when selecting an appropriate infant formula.

## Breast milk is best

Breastfeeding remains the best source of nourishment for infants and young children, as well as one of the most effective ways to ensure child health and survival.

Breast milk and exclusive breastfeeding have many advantages over formula feeding for the growing infant:

- The unique composition of breast milk meets all the nutritional needs of the growing infant, in most cases up to the age of six months.
- Breast milk contains antibodies which help protect infants from common childhood illnesses such as diarrhoea and pneumonia (the two primary causes of child mortality worldwide).

Breastfeeding also provides several benefits for breastfeeding mothers, such as reducing the risks of breast and ovarian cancer later in life and helping mothers to return to their pre-pregnancy weight faster.

Despite the numerous benefits of breastfeeding, it is unfortunately not always an option, as many women are unable to or choose not to breastfeed.

Attempts to create substitutes for human breast milk started as early as the mid-1800s, but most were met with disastrous results. Until the end of the 19<sup>th</sup> century, the use of a wet nurse was by far the safest way to feed infants who could not be fed by their biological mothers. However, as sanitation measures improved, and as differences in the composition between human milk and that of other mammals were defined, feeding infants with animal milk, particularly cow's milk, became more successful.

In 1867 Henri Nestlé experimented with various combinations of cow's milk, wheat flour and sugar in an attempt to find an alternative source of nutrition for the premature child of a neighbour who was unable to breastfeed. During the same year Justus von Lieberg marketed a mixture of wheat flour, cow's milk and malt flour cooked with bicarbonate of potash. The success of these products laid the foundation for modern infant formulas.

A variety of infant formulas are available for healthy full-term infants who are not breastfed or who are partially breastfed. Most of these are available in a powder form that requires mixing them with water, but ready-to-use liquid formulas are also available.

Infant formulas can be classified into broad categories according to their usage:

- Starter formulas for use between birth and six months.
- Follow on formulas for use from six to 12 months of age.
- Growing up milks for one to three years of age.

While it is not always easy to determine into which category a formula falls, a reasonable rule of thumb is that if the whey fraction of the protein makes up 50% or more of the total protein, it is likely to be a starter formula. Table I gives examples of the baby formulas available.

**Table I:** Summary of infant formulas

Infant formula	Examples of commercially available formulas	Age of infants	Comments
<b>Starter formulas</b> Whey dominant	Infacare® 1 Infacare® Gold 1 Infacare® Nurture 1 NAN® 1 Protect Start S26® S26® Gold	From birth Can be continued to one year of age	Composition closest to breast milk Whey dominant is easily digestible
Casein dominant	SMA® 1 Lactogen® 1 Novalac® SD	May be used from birth, but generally recommended from three to six months	Takes longer to digest, so baby stays satisfied for longer
<b>Follow-on formulas</b>	Infacare® 2 Infacare® Gold 2 Infacare® Nurture 2 S26 Promil® 2 S26 Promil® Gold 2 Lactogen® 2	From six months	Casein dominant with higher sodium and protein content
<b>Soy-based formulas</b>	Infacare® Soya 1 and 2 Infacare® Gold Soya 1, 2 and 3 Similac® Isomil Advance Isomil® 1 and 2 Infasoy® 1 and 2	1: From birth 2: From six months	For indications, see text.
<b>Hypoallergenic formulas</b> Amino acid mixture	Neocate®	From birth	For use in infants intolerant to cow's milk protein, soy protein and protein hydrolysate
Extensively hydrolysed	Alfaré® (whey) Similac® Alimentum (casein)		For use in infants intolerant to cow's milk protein and soy protein
Partially hydrolysed	Infacare® Nurture HA Comfort NAN® HA 1 and 2 (whey) Novalac® HA 1 and 2 (whey) Similac® Advance HA (whey)	1: From birth 2: From six months	Designed to help prevent allergies in healthy infants at risk of developing allergy
<b>Lactose-free formulas</b>	Infacare® Nurture LF NAN® Lactose Free S26® LF	From birth	Lactose intolerance and post-gastroenteritis Soy-based formulas are also lactose free
<b>Anti-regurgitation formulas</b>	Infacare® AR (casein) Infacare® Nurture AR (casein) Novalac® AR 1 and 2 (casein) NAN® AR (whey)	0-12 months	These formulas thicken in the stomach, reducing the possibility of regurgitation
<b>Acidified cow's milk formulas</b>	Melegi® Acidified NAN® Pelargon®	From birth	Acidified formula inhibits growth of harmful bacteria For use in areas with less than ideal hygiene

## Cow's milk formulas

### Birth to 12 months

Most infant formulas are manufactured from cow's milk which has undergone many modifications to make it suitable for human infants.

Cow's milk formulas broadly fall into two groups:

*Highly modified, whey-dominant starter formulas:* These formulas (e.g. Infacare® 1, Infacare® Gold 1, Infacare® Nurture 1, S26® Gold 1, NAN® 1 Protect Start) are modified to such an extent that their nutrient composition is very close to that of human milk. They contain a higher proportion of whey to

casein (resulting in a softer curd resembling breast milk), making them more digestible. These formulas are usually recommended in the first four to six months of life, but may be continued until one year of age, if the baby is satisfied and growing well. Most infants remain contented until at least six months. However, after eight months some babies do not find these feeds sufficiently satisfying and may be moved on to casein-predominant starter formula.

*Partially modified, casein-dominant starter formulas:* These formulas (e.g. SMA<sup>®</sup> 1, Lactogen<sup>®</sup> 1, Novalac<sup>®</sup> SD) have been modified to contain a higher proportion of casein than that present in breast milk. Their composition is somewhere between human and cow's milk. Casein takes longer to digest, so the baby stays satisfied for longer. These milks are suited to the larger full-term baby and the "hungry" baby, until one year of age. Since they may stress the relatively immature organ systems of the young infant, they are generally only recommended for infants from three to six months of age.

### Follow-on formulas

These formulas (e.g. Infacare<sup>®</sup> 2, Infacare<sup>®</sup> Gold 2, Infacare<sup>®</sup> Nurture 2, S26<sup>®</sup> Promil 2, S26<sup>®</sup> Promil Gold 2) have a higher protein and sodium content and are casein-based, preparing the child for unmodified or partially modified full-cream cow's milk which may be introduced into the diet after one year of age. Some formulas have added probiotics which claim to strengthen the immune system.

Some of these formulas may be used for babies from six months of age who become hungry on starter formula or do not gain adequate weight, while others are only recommended for infants from one year of age.

### Soy-based infant formulas

It is well known that cow's milk proteins may be allergenic in some individuals, especially in those with a positive family history of allergies. For years, soy formulas (e.g. Infacare<sup>®</sup> Soya 1 and 2, Infacare<sup>®</sup> Gold Soya 1, 2 and 3, Isomil<sup>®</sup> 1 and 2, Similac<sup>®</sup> Isomil Advance Advance, Infasoy<sup>®</sup> 1 and 2, Infacare<sup>®</sup> Soya 1 and 2) have been used as a cow's milk substitute to feed babies with an allergy to cow's milk protein.

Soy milk is a safe and effective alternative to cow's milk-based formulas. Soy formulas fall into a similar category with partially modified formulas in terms of their composition and are, therefore, not generally recommended in the first three to six months of life.

Soy-based infant formulas may be indicated in the following situations:

- Infants with documented immunoglobulin E-mediated allergy to cow's milk protein.
- Infants whose parents seek a vegetarian diet for their full-term infant.
- Infants with galactosaemia.

### Hypoallergenic formulas

A number of formulas have been developed for infants intolerant to cow's milk or soy-based infant formulas, or for those with a family history of allergies.

According to the American Academy of Pediatrics, to be labelled hypoallergenic, "formulas, after appropriate preclinical testing, must demonstrate that they do not provoke reactions in 90% of infants or children with confirmed cow's milk allergy when given in prospective randomised, double-blind, placebo-controlled trials."

These formulas vary in the degree to which the protein source has been modified. Hypoallergenic formulas may contain partially hydrolysed protein, extensively hydrolysed protein or free amino acids. Formulas containing extensively hydrolysed proteins and free amino-acid based formulas are considered hypoallergenic and are recommended for infants with established allergies. Partially hydrolysed formulas are not hypoallergenic and should not be used in infants with documented allergies, but may be recommended for infants at high risk of allergy, e.g. a family history of allergic conditions (Table II).

**Table II:** Examples of hypoallergenic baby formulas

<b>Extensively hydrolysed</b>
Alfaré <sup>®</sup> (whey)
Similac <sup>®</sup> Alimentum (casein)
<b>Amino acid mixtures</b>
Neocate <sup>®</sup>
<b>Partially hydrolysed</b>
Infacare <sup>®</sup> Nurture HA Comfort
NAN <sup>®</sup> HA (whey)
Novalac <sup>®</sup> HA (whey)
Similac <sup>®</sup> Advance HA (whey)

Hypoallergenic formulas are significantly more expensive than either cow's milk or soy-based infant formulas. Their taste is also altered significantly during protein hydrolysis and these formulas may not be well accepted by some infants.

### Lactose-free formulas

True lactose intolerance in infants is a rare condition and the result of infants producing insufficient amounts of lactase

(the enzyme needed to break down lactose). Premature infants may have lower levels of lactase than term infants, as lactase activity develops during the last trimester of pregnancy. Transient lactose intolerance may occur following acute diarrhoea, but enzyme activity is quickly restored and switching to a lactose-free formula is not usually necessary.

Several cow's milk-based formulas are indicated for infants with lactose intolerance. In addition soy-based formulas are lactose free and may be used as an alternative in lactose-intolerant infants. Examples include Infacare® Nurture LF, NAN® lactose free and S26® LF (whey).

### Thickened formulas for regurgitation

Many infants have an immature or weak lower oesophageal sphincter allowing the reflux of milk and stomach acid. There are several anti-regurgitation/antireflux formulas on the market [e.g. Infacare® AR (casein), Infacare® Nurture AR (casein), Novalac® AR (casein dominant), NAN® AR (whey)], which have been formulated for these infants, using starch. The addition of starch causes the feed to thicken once it reaches the stomach, hence minimising the possibility of regurgitation.

Nestargel® is a special thickener that may be added to feeds. However, it should not be used as a source of nutrition.

### Acidified cow's milk formulas

Melegi® Acidified and NAN® Pelargon are biologically acidified infant formulas that inhibit the growth of harmful bacteria in the prepared feed. Acidified milks provide some advantage over nonacidified formulas in children with mild digestive problems, or in areas that have less than ideal hygiene.

### Formulas for preterm and low-birth-weight infants

These formulas (e.g. Similac® Special Care, PreNAN®) are used in preterm or full-term babies with low birthweight. There are also formulations available to fortify breast milk in the case of very small babies, e.g. FM85®. These products are generally used in hospitals only until the baby reaches the required weight.

### Tips for the safe preparation of infant formula

- Wash hands with soap and water before preparation.
- Bottles and nipples should be washed thoroughly and sterilised between uses.

- Discard formula left at room temperature for more than two hours.
- Never heat formula bottles in a microwave oven.
- Use refrigerated bottles of infant formula within 24 hours of preparation.
- Before opening a tin of formula, wash the tin lid with soap and water to remove bacteria, dust and any other substances that could contaminate the infant formula when opened.
- Boil and cool clean water to no less than 70°C before adding to the infant formula (do not allow water to stand for more than 30 minutes before adding the formula).
- Quickly cool the bottle to the desired temperature by placing it in a container full of ice water before feeding the infant.

### Conclusion

With the wide variety of infant formulas available, the choice of a particular formula needs to be made on a rational, scientific and individual basis. The family practitioner is well placed to educate parents on the appropriate selection of infant formulas, while always encouraging breastfeeding as the best option where possible.

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