

Artificial nutrition of the infant

According to the recommendations of the Czech Pediatric Society, ESPGHAN, WHO and AAP, exclusive breastfeeding is preferred up to 6 months of age and then, simultaneously with the gradual introduction of foods, continue breastfeeding up to 2 years and beyond. Children who cannot or are not breastfed receive infant formula (substitute infant formula) as a substitute for breast milk. ^[1]

From the 2nd week of life, breastfed children and children fed with infant formula are given preventively vitamin D (cholecalciferol) in a dose of 500 IU (1 drop) per day during the entire first year and then during the winter months in the 2nd year of life. Infant formulas contain sufficient vitamin K. ^[2]

Infant nutrition can be divided into three periods:

1. period of exclusively milk feeding (up to the completed 4th month) — feeding by breastfeeding and/or initial formula in an amount corresponding to 1/6 of the child's weight (i.e. 150-180 ml/kg/day), maximum 1 liter per day^{[3][4]};
2. transitional period (from 4 to 6 months) — introduction of complementary foods and transition to continued formula; if the child is doing well and not hungry, the initial formula can be continued; exclusive breastfeeding is preferred until 6 months of age;
3. mixed diet period (from the end of the 6th to the end of the 12th month) — continued formula (possibly continuing the initial formula) and the gradual introduction of a modified adult diet suitable for the child.^{[1][4]}

These periods are determined not only by the functional maturity of the digestive system, but also by psychomotor development and the functional ability of the kidneys.^[4]

If the child is thriving and not hungry, the initial formula can be given until the completed 12th month. The continuing formula is determined from the completed 4th month until the completed 36th month of age.^[1]

Breast milk composition is a guide for the production and composition of infant formulas (substitute infant formula), however, even with theoretically absolute agreement, there will always be differences in bioavailability and the resulting metabolic effect. Therefore, it is not enough to only compare the composition, but it is necessary to evaluate the overall effect on the physiological development of the biochemical value and the function of organs and systems.^[1]

The basis for the production of formulas is cow's milk, rarely the milk of other mammals or vegetable proteins. Cow's milk protein must be modified ("adapted"), i.e. change the whey to casein ratio from 2:8 to 1:1 or even higher.^[1]

Initial formula

Initial formulas are intended for healthy full-term babies from day 1 of life. If the child is thriving and not hungry, the initial formula can be given until the completed 12th month.

Ingredients:

- proteins: adapted cow's milk protein
- carbohydrates: lactose and a small amount of other carbohydrates (gluten-free starches, maltodextrins — limited); maltodextrins can cause bloating and infant colic;
- fats: linoleic and alpha-linolenic acid, long-chain polyunsaturated fatty acids (LC-PUFA) including docosahexaenoic acid (DHA) and/or arachidonic acid (ARA); they cover about half of the child's energy needs in the first 4-6 months of life;
- minerals, trace elements and vitamins in precisely defined quantities.^[1]

It has not been proven that adapted milks are more beneficial from a nutritional and physiological point of view, but they are more digestible, especially suitable for premature babies.^{[3][4]}

Breast milk contains only lactose and a certain amount of oligosaccharides. Maltodextrins must not be more than 2 g/100 ml in the initial milk, because pancreatic juice does not have sufficient activity at this age and maltodextrins can therefore cause flatulence and colic. A child who receives sucrose right from the start gets used to the sweet taste.^[4]

Continued formulas

Continuing formulas are intended for healthy full-term babies from 4 to 6 months to 36 months of age. It is first introduced into the diet simultaneously with the introduction of complementary food (side dishes).

Differences in composition compared to the initial formulas:

- cow's milk protein with an unchanged ratio of whey to casein, i.e. 2:8; lower protein content compared to

- untreated cow's milk;
- may contain sucrose;
- minerals, trace elements and vitamins in the amount needed in the second half of life.^[1]

Special formula

Anti-reflux (anti-regurgitation) formula

- Reduces the frequency of overt regurgitation but does not prevent gastroesophageal reflux (GER) – increases the quality of life and comfort of the infant and his family;
- thickened with potato starch or carob – locust bean fiber;
- requires teat with larger opening;
- may cause coughing during feeding;
- no known effect on the natural course of GER or on the development of GERD.^{[1][4]}
- Eg: *HiPP AR BIO®*, *Beba A.R.®*, *Nutrilon 1 AR®*, ...

Lactose-reduced formula

- Contains traces of lactose;
- designed for infants with temporary lactase deficiency.^[1]
- Eg: *Nestlé AL110®*, *Nutrilon 1 Low Lactose®*, ...

Formula with reduced antigenicity (HypoAntigenic/Partly Hydrolysed-Prevention)

- Formula with partially hydrolyzed protein;
- to prevent allergy in newborns with a family history of atopic disease (however, the best prevention is breastfeeding);
- should not be routinely administered to newborns at a time when lactation is expected to develop in the mother.^[5]
- Eg: *HiPP HA Combiotic®*, *Beba H. A.®*, *Nutrilon 1 HA®*, ...

Extensively Hydrolysed (HypoAllergenic/Extensively Hydrolysed-Treatment)

- For infants with proven cow's milk protein allergy (ABKM).^[5]
- Eg: *Nestlé Nutrition ALTHÉRA®*, *Nestlé Nutrition ALFARÉ®*, *Nutrilon 1 Allergy Care®*, *Nutrilon 1 Allergy Digestive Care®*, ...

Amino Acid Formula

- Drug of first choice in infants:
 - with severe anaphylactic reactions,
 - with severe enteropathies accompanied by hypoproteinemia and failure to thrive,
 - with polyvalent food allergies.^[5]
- Eg: *Alfamino®*, *Neocate®*, ...

The higher the degree of protein cleavage, the lower the antigenicity and the worse the taste.^[4]

Soy formula

- Made from soy — lactose-free;
- possible substitute for formulas based on cow's milk;
- no long-term adverse effects have been demonstrated in healthy full-term infants;
- is most often used in the following cases:
 - galactosemia;
 - transient lactase deficiency;
 - families with a vegetarian/vegan diet.^[1]
- Eg: *Nutrilon 1 Soya®*, ...

It is a vegetable protein, so it must be enriched with methionine, carnitine, taurine, cystine, calcium, [[iron|iron]], trace elements and vitamins. 30-50% of children with cow's milk protein allergy will also develop soy protein allergy (not the treatment of choice today). In no case should it be confused with the so-called soy milks commonly available on the market.^{[3][4]}

Milk for premature babies and low birth weight babies

- Even breast milk is not ideal for children with a very low birth weight - that's why there are preparations to enrich breast milk (so-called fortification preparations).
- They need more energy and protein, the fat composition is also adjusted,
 - we also add polyunsaturated MK with long chains (arachidonic acid, ...).
- There must be more vitamins, calcium, phosphorus, sodium, iron.^{[3][4]}
- Eg: *Nutrilon Nenatal 0 a 1®*, *Pre Beba Preemie a Discharge®*, ...

	! Fully adapted milk for a full-term baby	Milk for premature babies^[6]
Energy (kcal)	67	80
Protein (g)	1,4	2,2
Fats (g)	3,6	4,4
Carbohydrates (g)	7,1	8,0
Ca (mg)	54	108
P (mg)	27	54
Fe (mg)	0,5	0,9
Na (mg)	18	32
Vitamin D (IU)	44	96

Probiotics and prebiotics in infant formulas

Some infant formulas contain prebiotics, probiotics and synbiotics. **Prebiotics** are indigestible substances that selectively support the growth or activity of certain intestinal bacteria, thereby positively influencing the composition of the intestinal microbiome. **Probiotics** are many mixed cultures of living microorganisms that improve the intestinal microbiome. **Synbiotics** are combinations of probiotics and prebiotics, where the prebiotic is a specific substrate for the given probiotic and leads to prolonging its survival.

Probiotics in infant formulas do not have any side effects, however, no positive effect on reducing infections or colic in infants up to 4–6 months has yet been proven. Only a small number of studies have been conducted so far. Infant formulas enriched with "Bifidobacterium lactis", ev. in combination with "Streptococcus thermophilus" and possibly still with *Lactobacillus helveticus* in older infants probably reduce the risk of gastrointestinal infections. However, long-term benefits have not yet been sufficiently proven. *Lactobacillus reuteri* can have a positive effect in infant colic.

Preventive administration of probiotics (*Lactobacillus acidophilus*, *Bifidobacterium sp.*) significantly reduces the risk of necrotizing enterocolitis and mortality in premature babies. There is not yet enough evidence for the routine administration of prebiotics and probiotics to pregnant women and infants for the prevention of allergic diseases.^[7]

Unmodified mammalian and vegetable milks

- do not meet the criteria and standards of infant formula;
- unprocessed cow's milk – more frequent occurrence of occult bleeding, excessive load on the kidneys (higher protein and mineral content), high antigenicity;
- unprocessed goat's milk – excessive load on the kidneys (higher protein and mineral content), risk of vitamin deficiency (C, D, B12, folic acid) and iron;
- soy milk for older children and adults – not to be confused with soy formula.^{[1][4]}

Comparison of mother's milk and cow's milk

Content of basic nutrients in 1 liter of milk^[8]

	Breast milk	Cow milk
Protein (g)	10	33
Fats (g)	39	38
Carbohydrates (g)	72	47
Energy (kcal)	680	680

Links

Related Articles

- Children's nutrition: Newborn nutrition • Breastfeeding • Infant artificial nutrition • Non-dairy infant food • Toddler nutrition • Preschool, school nutrition children and youth • Recommendations for infant nutrition 2011 • Recommended nutrient intake (pediatrics)
- Nutrition recommendations: Nutrition recommendations (1. LF UK, NT) • Nutrition recommendations for the adult population • Nutrition for pregnant and lactating women • Nutrition in old age • Factors affecting nutritional needs
- Special Nutrition
- Food composition: Carbohydrates in food • Proteins in food • Fats in food • Mineral substances in food • Trace elements in food • Vitamins • Microorganisms in food • Foreign substances in food

- Failure to thrive • Eating disorders • Nutrient excess or deficiency disease • Food allergy • Food intolerance • Cow's milk protein allergy

Reference

1. Pracovní skupina dětské gastroenterologie a výživy. Doporučení pracovní skupiny gastroenterologie a výživy ČPS pro výživu kojenců a batolat. *Česko-slovenská pediatrie*. 2014, y. april/2014, p. 10-18, ISSN 0069-2328.
2. Pracovní skupina dětské gastroenterologie a výživy. Doporučení pracovní skupiny gastroenterologie a výživy ČPS pro výživu kojenců a batolat. *Česko-slovenská pediatrie*. 2014, y. april/2014, p. 23, ISSN 0069-2328.
3. BENEŠ, Jiří. *www.jirben.wz.cz : Studijní materiály* [online]. [cit. 15.2.2023]. <<http://www.jirben.wz.cz/>>.
4. HRODEK, Otto – VAVŘINEC, Jan – A KOLEKTIV,. *Pediatrie*. 1. edition. Praha : Galén, 2002. pp. 92-96. ISBN 80-7262-178-5.
5. Pracovní skupina dětské gastroenterologie a výživy. Doporučení pracovní skupiny gastroenterologie a výživy ČPS pro výživu kojenců a batolat. *Česko-slovenská pediatrie*. 2014, y. april/2014, p. 26-30, ISSN 0069-2328.
6. PEYCHL, Ivan. *Nedonošené dítě v péči praktického a nemocničního pediatra*. 1. edition. Galén, 2005. pp. 56. ISBN 80-7262-283-8.
7. Pracovní skupina dětské gastroenterologie a výživy. Doporučení pracovní skupiny gastroenterologie a výživy ČPS pro výživu kojenců a batolat. *Česko-slovenská pediatrie*. 2014, y. april/2014, p. 21-22, ISSN 0069-2328.
8. NEVORAL, J. *Výživa v dětském věku*. 1. edition. H & H, 2003. pp. 436. ISBN 80-86022-93-5.