

Breast Feeding

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Breastfeeding

The World Health Organization (WHO) recommends breast milk as the only food or drink offered to infants during the first 6 months of life ^[1]. To promote breastfeeding, mothers should be empowered to initiate skin-to-skin contact with their infant immediately after birth for at least one hour ^[2]. Exclusive breastfeeding is recommended for the first 6 months, with continued breastfeeding for 2 years or more, with the appropriate introduction of solid foods ^[3].

The first milk produced by the mother is known as colostrum. This thick creamy milk is rich in protein and antibodies, which help the baby ward off infection ^[4]. Colostrum is highly nutritious and is the perfect first food for the infant ^[4].

Exclusive breastfeeding promotes optimal growth and development. In developing countries, "the most important benefit of breastfeeding is the infant's immediate survival ^[5]". The chance of survival in the early months is at least six times greater among children who are breastfed compared to those who are not ^[6]. Breastfeeding reduces the risk of death from acute respiratory infection and diarrhea, as well as other infectious diseases ^[5].

Each mother's milk is unique and provides the right amount of protein, carbohydrate, fat, vitamins and minerals for her infant at each stage of development ^[1]. In addition to its nutritional components, breast milk also contains immune factors that help protect the infant from infection and disease ^[1]. Breastfeeding supports the development of the infant's immune systems and helps decrease the risk of infection and illness during childhood, as well as the risk of chronic conditions, such as obesity and diabetes later in life ^[3].



Woman breastfeeding

Vitamin D

Vitamin D is necessary for proper bone development. Vitamin D deficiency may occur among breastfed infants who do not receive much exposure to sunlight ^[7]. In developed countries, mothers are recommended to give breastfed infants Vitamin D drops to help prevent deficiency. Breast milk substitutes are fortified therefore supplementation is not necessary in infants who are not breastfed.

Importance of Breastfeeding

There are many reasons why a mother should breastfeed. Breastfeeding is associated with important short and long-term health outcomes for both mother and child. Breastfed infants are at lower risk of ear infections, respiratory illnesses, allergies, diarrhea and sudden infant death syndrome ^[4]. Long term, breastfed children are at lower risk of childhood leukemia, diabetes, asthma, obesity, and have higher IQ scores ^{[4][8]}.

For the mother, breastfeeding helps reduce the risk of post-partum haemorrhage, postpartum depression, and delays the return to fertility. Long term mothers who breastfeed are at decreased risk of osteoporosis, ovarian and breast cancer ^[4]. Both mother and child benefit from early skin-to-skin contact as this helps to establish a bond that promotes healthy social emotional development ^[2].

Complementary Feeding

At 6 months, the child's nutritional needs begin to change and developmentally they are ready to begin eating small amounts of family foods. Breast milk continues to be the child's main source of nourishment well beyond the first year of life^[7]. At 6-8 months, the child should be offered small meals of complementary foods 2-3 times per day. The first foods introduced should be smooth in texture to minimize the risk of choking. Parents and caregivers should be encouraged to increase the quantity of food, as the child gets older, while maintaining frequent breastfeeding^[7]. By 9 months, meals of complementary foods should be offered 3-4 times per day with nutritious snacks offered between meals 1-2 per day^[7].

Parents and caregivers should offer a variety of foods to ensure the child's nutrient needs are met^[7]. Early on, iron rich foods are particularly important because by 6 months the infant's iron stores have been depleted^[9]. Therefore, meat, poultry, fish or eggs should be eaten daily, or as often as possible^[7].

Continue to modify the texture, progressing from smooth to a slightly more lumpy texture, and finally to small pieces of food when the child is developmentally ready^[9]. As the child continues to grow, offer a variety of foods from each food group. Parents and caregivers should be encouraged to pay attention to their child's hunger and satiety cues, sit with their child while eating, and make meal times pleasant.

Contraindications to breastfeeding

Absolute contraindications:

- from the child's side:
 - classic form galactosemia with zero activity of gal-1-puridyltransferase in erythrocytes;
- on the mother's side:
 - HIV/AIDS infection (applicable only in developed countries);
 - HTLV 1, 2 infection.^[10]

Partial Contraindication:

- from the child's side:
 - phenylketonuria – according to individual phenylalanine tolerance;
 - other metabolic defects – according to consultation with the center of metabolic defects;
- on the mother's side:
 - drug abuse.^[10]

Temporary Contraindication:

- on the mother's side:
 - herpes zoster, herpes simplex on the breast – do not breastfeed the child from the affected breast until the lesions disappear (regularly express and pour milk), you can breastfeed from the other breast;
 - cytomegalovirus – for premature babies of seropositive mothers, consider the benefits and risks of breastfeeding;
 - chickenpox that appears within 5 days before delivery and within 2 days after delivery - isolate the mother from the child until the blisters burst, give the child varicella-zoster immunoglobulin; the baby can be given expressed mother's milk;
 - active tuberculosis – separate the mother from the child until the treatment begins to work and the mother is no longer infectious, give the child vaccination and chemoprophylaxis; the baby can be given expressed mother's milk;
 - radioactive isotopes – use radionuclides with the shortest possible half-life; interrupt breastfeeding for a period 5 times longer than the half-life;
 - chemotherapy;
 - some drugs (the list is available on the website TOXNET (<https://toxnet.nlm.nih.gov/newtoxnet/lactmed.htm>)).^[10]

Medicines absolutely contraindicated during breastfeeding:

- cytostatics, immunosuppressants, estrogens (they reduce lactation), addictive substances (heroin, cocaine, amphetamine); ergot alkaloids (bromocriptine, ergotamine), lithium, gold salts, radioactive isotopes.^[11]

'No contraindications:

- on the mother's side:
 - hepatitis A, B, C (consider breastfeeding in acute HBV infection of the mother, i.e. if the mother is HBsAg and HBeAg positive and anti-HBe negative)^{[11][11]};
 - febrile conditions, viruses, mastitis, vaccination, diseases of the digestive or uropoietic tract;
 - smoking – the mother is advised to stop smoking;
 - occasional consumption of alcohol 2 hours apart from the next breastfeeding.^[10]

Physiology of Lactation

Breast milk is formed *in the epithelial cells of the alveoli* of the mammary gland and is secreted into the alveoli, from where it flows through the small and large milk ducts into the wide sinuses in the area of the areola. These sinuses then open on the nipple. Growth and differentiation of the mammary gland as well as milk production are under endocrine control.^[12]

After the expulsion of the placenta during childbirth, a large amount of prolactin is released from the adenohypophysis, which triggers the production of milk in the first days after childbirth. The hormone prolactin plays a key role in lactation. Frequent breastfeeding early after birth stimulates the development of prolactin receptors in the mammary gland. Delaying suckling after birth leads to lower prolactin levels and thus fewer stimulated prolactin receptors.^[13]

'During sucking of the baby, nerve impulses are sent from the breast to the neurohypophysis, which *releases oxytocin*. Under the influence of oxytocin, the myoepithelial cells of the milk ducts contract and the milk moves from the alveoli towards the nipple ("milk ejection reflex" or "let-down reflex"). Initially an unconditioned reflex, it soon becomes conditioned and can be inhibited by anxiety and pain.^[13]

Initially, lactation is hormonally controlled and colostrum production occurs independently of suction. Colostrum is thick, produced in small quantities (4-14 ml at each feeding). Over the next 48-96 hours, milk production increases significantly and the amount produced is controlled by suction and demand (the amount of milk removed). These events are crucial for the continuation of lactation. After 1-2 weeks, the average milk production is 700-800 ml/day (with significant individual variability of 450-1200 ml/day). At the end of each feeding, about 100 ml of milk remains in the breast. Infants appear to be able to self-regulate their milk requirements to grow normally, so assessment of breast milk intake is only appropriate if weight gains are unsatisfactory.^[13]

Milk is produced while it is being removed from the breast. The rate of milk production may differ between the two breasts if the length and frequency of sucking is not the same. It can be concluded from this that autocrine regulation of milk secretion occurs in each breast separately, by the formation of a local factor (the so-called *feedback inhibitor of lactation*).^[13]

Main principles of breastfeeding

Development of lactation in the maternity ward':

- support breastfeeding without limiting the length and frequency - breastfeed according to the child's taste;
- put the child to the breast at least 8-12 times in 24 hours (possibly even more often);
- breastfeed from both breasts during one feeding;
- signs of the child's readiness for breastfeeding: alertness, activity, opening the mouth and seeking the breast; crying is a late sign of hunger.^[10]

Developed lactation after discharge from maternity hospital:

- during the first examination of PLDD, assess the child's nutritional status, evaluate the success of breastfeeding according to the number of stools (3-6 per day in the first 6 weeks, then the absence of stool for several days is possible), wet diapers (6-8 per day) and observation of breastfeeding, assess icterus;
- breastfeed only from one breast during one feeding;
- a healthy breastfed baby does not need any other fluids, food, food supplements or other milk in addition, except for medically indicated cases;
- in the case of indicated supplementary feeding, administer complementary feeding in an alternative way, i.e. through a breast or finger probe, a cup, a spoon or from a supplementer;
- do not use bottles and pacifiers - they spoil the breastfeeding technique, especially in the first 6 weeks, before breastfeeding stabilizes;
- do not routinely use nipple caps - use only for inverted or flat nipples;
- after breastfeeding, only spray if there is an excess of milk;
- take into account the need for more frequent breastfeeding during growth spurts, i.e. 3rd and 6th week, 3rd and 6th month;
- monitor weight gain - between weeks 2 and 3, the baby should reach its birth weight and then gain an average of 125-200 g per week in the first 6 months; growth along percentile graphs (<http://www.szu.cz/publikace/data/seznam-rustovych-grafu-ke-stazeni>).
- a nursing mother should follow the principles of proper nutrition, not smoke, not drink alcohol; she should not lose weight rapidly (when fat is mobilized, harmful substances such as polychlorinated biphenyls, chlorinated hydrocarbons and heavy metals would be released into breast milk)^[14]; from the point of view of preventing allergies in the infant, no specific dietary measures for the mother are recommended;
- you can breastfeed during the next pregnancy.^[10]

Composition of breast milk



The composition of breast milk corresponds to the needs of the newborn. In the first days after birth, colostrum is formed, which is rich in immunoglobulins and has a lower lactose content. After a few days it turns into mature milk. The caloric value of breast milk is approx. 67 kcal/100 ml.^[15] Composition of breast milk - carbohydrates: 10 g/100 ml, fats: 5 - 6 g/100 ml, proteins: 1.5 g/ 100 ml.^[16]

Colostrum (colostrum)

- Produced during the first week.
- Contains **more protein**, less fat and carbohydrates.
- Rich in macrophages, lymphocytes, granulocytes, secretory IgA.
- It has a lower energy content, approx. 56 kcal/100 ml.^[12]
- Thick, creamy yellow liquid.
- It is well adapted to the needs of the fresh newborn - the kidneys are not yet able to eliminate the fluid load, low production of lactase in the intestine, vitamin A and E protect before oxidative stress, vitamin K reduces the risk of hemorrhage.

Transition milk

- Formed 2nd to 3rd week after birth.
- Contains less protein, more fat and carbohydrates.^[12]

Mature breast milk

- Formed about 3 weeks postpartum.^[12]
- Breast milk does not have a constant composition. Significant changes occur not only during lactation, but also during the day and during each feeding.
- Energy content is about 60-70 kcal/100 ml.^[17]

Proteins

- Breast milk (MM) contains 'about 1 g of protein per 100 ml, which is relatively little.
 - The protein content of mammalian milk probably corresponds to the postnatal growth rate of the young. In humans, the postnatal growth of children is very slow compared to other mammals, and the protein content of breast milk is also very low. E.g. cow's milk contains about 3.5 g of protein per 100 ml.
- Proteins are represented by `` primarily whey and casein. Whey represents about 60% of all proteins in MM and is of high nutritional value, containing many **essential amino acids**.^[17] **The ratio of whey : casein is 70 : 30.**^[12]
 - Cow's milk (KM), on the other hand, is dominated by casein and whey makes up only 20% of the protein. Casein can coagulate at low pH (e.g. in an infant's stomach) to form lumps ("curds").
- α -lactalbumin is the most abundant in MM serum, followed by lactoferrin.
 - The main protein in cow's milk whey is β -lactoglobulin, which is completely absent in human MM and is therefore potentially antigenic for children. α -lactalbumin is contained in cow's milk, lactoferrin is present only in small amounts.
- MM contains twice **more cysteine** than KM, and the methionine/cysteine ratio is 7× lower in MM than in KM. Cystathionase, the enzyme that converts methionine to cysteine, develops later, so cysteine could be an essential amino acid for newborns.
- MM contains relatively 'little tyrosine and phenylalanine' - probably because the child is not sufficiently able to metabolize these amino acids.
- Very **high in non-protein nitrogen** (about 25% in MM, while 6% in KM) - free amino acids, urea, creatinine, creatine, uric acid and ammonia. From a nutritional point of view, free amino acids should be counted as proteins. For other non-protein sources of nitrogen, it is not clear whether they have any nutritional value.
- MM contains significantly **more taurine** (free amino acid) than KM. Taurine deficiency leads to retinal dysfunction.
- At the beginning of lactation, there is significantly more protein in MM than in mature MM. Declining protein content may reflect the infant's declining need or may simply be the result of mammary gland maturation.^{[17][12]}

Fats

- Fat content in individual MM

mothers is very **variable**. It usually increases at the beginning of lactation (in the first 1-2 weeks) and then decreases. The fat content rises significantly during one breastfeeding/feeding up to about double^[17], according to other sources even up to 4-5 times^[12].

- Fats are the main **energy source**. They cover 50% of the energy needs of infants.^[12]
- They are a source of essential fatty acids (linoleic, α -linolenic, arachidonic, docosahexaenoic acid) and fat-soluble vitamins. Saturated arachidonic and docosahexaenoic are very important for the development of the CNS and the retina.
- Main lipid is **triglycerides** (90^[12] to 98%^[17]).
- Of the fatty acids, about 42% are saturated and 58% are unsaturated.^[12]
- The representation of individual fatty acids is significantly **influenced by the mother's diet** (fish and seafood → more long-chain polyunsaturated fatty acids, especially docosahexaenoic acid (DHA); vegetarianism → more fatty long-chain acids than with a mixed diet).
- MM contains lipase, which facilitates the absorption of fats.
- MM and KM have a similar fat content, but the main difference is the representation of individual fatty acids.

MM contains more unsaturated fatty acids and more essential fatty acids than KM. Fatty acids are esterified with glycerol mainly in the first position, unlike KM, which facilitates their absorption.^[17] MM contains 2-3 times more cholesterol than KM. ^[12]

- Humans and gorillas are the only mammals that also have lipase in their milk (therefore they have enzyme and substrate) because pancreatic lipase secretion is not yet sufficient.
 - Lipase is activated by bile acids in the intestine, it is thermolabile, it is degraded by overcooking.

Carbohydrates

- MM contains 7 g of lactose per 100 ml (KM 4.7 g/100 ml).
- **Lactose** facilitates the absorption of calcium in the intestines, lowers stool pH, supports the growth of bifidobacteria and lactobacilli in the intestinal flora, and limits the growth of E. coli.
- **Galactose** is a monosaccharide contained in lactose. It is important for brain growth and calcium resorption.
- **Oligosaccharides** are complex carbohydrate structures bound to lactose, often containing fructose and sialic acid. After lactose and fat, it is the 3rd largest component of breast milk (in colostrum they are even in twice the amount). They have a **prebiotic effect** - they support the growth of bifidobacteria. They have a similar structure to epithelial cell receptors, bind bacteria, bacterial toxins and viruses. They affect the adhesion of circulating leukocytes to endothelial cells and inhibit the pathogenicity of Campylobacter jejuni, enteropathogenic E. coli, Streptococcus pneumoniae and Vibrio cholerae. They increase the weight and frequency of stool. In KM, oligosaccharides are present only in trace amounts.
- Lactobacilli and bifidobacteria make up 90% of the intestinal flora of exclusively breastfed newborns. Gut flora influences the development of the infant's immune system.^{[12][17]}
 - Lactobacillus growth is also affected by another sugar from breast milk - the so-called "bifidus factor" - an oligosaccharide containing N-acetylglucosamine - which is not found in cow's milk at all.
 - → Infants fed with modified cow's milk are mainly colonized by coliform and putrefactive microflora and pH stools are higher than when breastfed.

Vitamins

- vitamin A - its amount is significantly higher in mother's milk than in cow's milk, it is mainly contained in colostrum.
- vitamin K - its content is high in colostrum, then decreases, after two weeks it begins to be produced by bacteria in the intestine. After birth, each full-term newborn receives 1 mg i.m. of vitamin K to prevent vitamin K deficiency bleeding. If administered orally, 1 mg of vitamin K per week must be administered to exclusively breastfed infants until 12 weeks of age.^[18]
- vitamin D - its content is low in breast milk. From the 2nd week of life, breastfed and formula-fed children 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. < ref name="Recommendation2"/>
- the content of water-soluble vitamins varies according to the mother's intake, usually their content is sufficient.

Mineral substances

- MM contains significantly less of all major minerals (K, Cl, Ca, P, Na, Mg) than KM. Minerals and proteins contribute to the high renal load of solutes of BM.
- MM initially has significantly more sodium (up to 10 times) than mature MM.^[17]
- Calcium (Ca)

is better absorbed from breast milk (better ratio to phosphorus - 2:1).

- The high concentration of phosphates in cow's milk leads to their preferential resorption and to the tendency to hypocalcemia.
- In addition, unabsorbed Ca together with FFAs become soaps in the intestine, which disrupt the absorption of fats and can even cause perforation of the intestine.

Breast milk provides a sufficient intake of calcium in the first 6 months, after which it is necessary to supply it, for example, from white yogurt.^{[19][20]}

Trace elements

- In MM and KM, the representation of trace elements (Zn, Fe, I, Cu, Mn) and also their bioavailability differ. For example, MM has less zinc and more copper. Iron and other minerals are more bioavailable in MM than in KM.
- Colostrum contains more copper, iron and zinc than mature MM.^[17]
- Zinc is part of 78 metalloenzymes involved in metabolism and immunity.

Iron

- MM contains a very small amount of iron, but it is very well absorbed (about 80% compared to 4-6% in fortified formulas).
- A full-term newborn has about 250-300 mg of iron (75 mg/kg body weight) in his body, which will cover his needs during the first 4-6 months of life. After that, his need for iron increases significantly (to about 0.7-0.9 mg/day until the end of the first year of life, which is a lot considering his body size). An infant almost doubles its iron stores (and triples its weight) during the first year of life.

- Hypotrophic neonate has lower iron stores at birth, therefore will be iron deficient earlier. In addition to birth weight, other factors such as the amount of iron in the mother during pregnancy or placental transfusion during delivery (delayed umbilical cord cutting increases the amount of iron in the baby) affect the initial iron store.
- Iron deficiency anemia is common in childhood, often asymptomatic.
- When introducing complementary foods, it is important to serve a diet rich in iron (e.g. red meat) or a diet enriched with iron.^[17]
- Iron – up to 70% of iron is absorbed from breast milk (30% from cow's milk).
 - the acidity of the environment is also good for absorption.
 - Lactoferrin in breast milk carries iron and prevents its uptake by bacteria.
 - Timely administration of non-dairy supplements does not have a good effect on iron (e.g. pear chelates it).

Fluorine

Breast milk is low in fluorine, so breastfeeding mothers are advised to take 200 µg of iodine per day unless they consume at least 2 servings of marine fish per week.^[18]

Other components of breast milk

- Breast milk contains many substances that regulate the growth and development of the child.
- Mammary gland acts as a polyfunctional endocrine organ (affects both mother and child).

Immunological aspects of breastfeeding

Breast milk (MM) contains immunoglobulins, mainly secretory IgA, *which reaches its highest concentrations in the first days after birth. Secretory immunoglobulin A is relatively resistant to low pH and proteolytic enzymes and can be detected in the stool of breast-fed infants. It has a protective effect probably only in the intestine and in the respiratory tract.*

Furthermore, there is a relatively low concentration of IgG in breast milk and it is not certain whether it is absorbed.

Various types of antibodies against viruses, bacteria and their toxins have been detected in MM, but their significance and fate in the gut is unclear. MM also contains relatively low concentrations of complement components, but their significance is not clarified either.

MM is a rich source of lysozyme, *which in vitro participates together with IgA in the lysis of E. coli and some salmonella, but its effect has not been confirmed in vivo.*

Lactoferrin, an iron-binding protein, reduces the level of free iron, which is a growth factor for pathogenic organisms. In vitro, lactoferrin has a bacteriostatic and bactericidal effect, in vivo its protective role is uncertain. The level of lactoferrin rises significantly during lactation, so it could be a growth factor.^[21]

- The mammary gland is a very powerful organ of immunity in its entire complex.
- Human colostrum contains $1-3 \times 10^6$ leukocytes.
 - 80-90% of these are macrophages filled with phagocytosed lipids, phagocytose yeast and bacteria.
 - 10% are lymphocytes, of which half are B and half are T.
- Effect of lactoferrin – competitive uptake of Fe (Fe is a growth and pathogenic factor of most bacteria).
- Lysozyme – has a direct bactericidal effect, it is practically not found in cow's milk
- Secretory IgA – a basic factor in the protection of the intestine against viruses and bacteria.
 - the so-called *homing phenomenon* - colostrum IgA is specifically directed against the microbes of the mother's intestinal microflora.
 - Microbes in the mother's GIT stimulate lymphocytes in the GALT, which travel to the mammary gland.

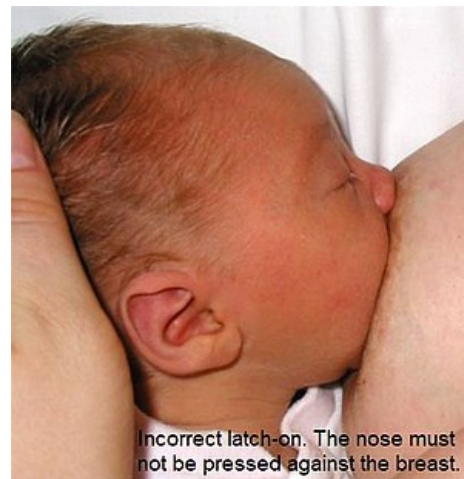
Medicines and breastfeeding

In general, all drugs pass more or less into breast milk depending on the physical and chemical properties.^[15]

- Most medicines enter the milk only in very small amounts.
- Even though some medicines have an effect on the baby, we would do more mischief if the mother did not breastfeed.
- **Drugs contraindicated during breastfeeding:** cytostatics, radiopharmaceuticals, thyrostatics, lithium, ergot preparations.
- **Relatively contraindicated drugs** (effect on the child is possible with longer administration and at higher doses): sulfonamides, ATB (chloramphenicol), hormones (estrogens), diuretics, antiepileptics and sedatives.
- Completely safe drugs (vast majority): bronchodilators, vitamins, iron, antihistamines, digoxin, insulin, analgesics – paracetamol, salicylates.
- **alcohol** - regular consumption of large amounts can cause failure to thrive
- **caffeine** - moderate drinking of coffee and drinks with caffeine does not harm the child
 - excessive supply will cause restlessness and sleep disturbances
- **nicotine** - the amount of about 5 cigarettes is not really harmful, but children often refuse the breast and are restless, the mother should only smoke after breastfeeding
- **drugs** - marijuana, cocaine, heroin - are contraindicated, moreover, they often reduce prolactin^[22]

Breastfeeding Technique

Correct breastfeeding technique consists in the correct position and the correct attachment of the child. In the correct position the baby's body is close to the mother and facing her ("belly to belly") and the mother supports the baby's entire body. In **proper positioning**, the baby's mouth is wide open, the lower lip is turned outwards, the chin touches the breast, and more of the areola is visible above than below the mouth. After a while of rapid suction movements, the suction slows down and you can hear the baby swallowing - **these are signs of effective suction**. When properly attached, the baby is gripping the areola with its gums, not the sensitive nipple, which is the cause of pain during breastfeeding and damage to the nipples. The mechanism of sucking from a bottle is different from sucking from the breast, which is confusing for the baby, so its use is not recommended for breastfed babies. If the child needs another liquid, it should be given from a cup or spoon.^[14]



Incorrect position

- **Position during breastfeeding** - initially the mother breastfeeds lying down, later sitting. The mother lies relaxed on her side, the baby's body is turned to the mother's body ("tummy on tummy").
- The newborn's mouth is at the level of the nipple. The mother is bent at the back so that her belly does not prevent her from pressing the child to her. The baby's nose and chin must touch the breast during breastfeeding. The mother draws the child to her, not herself to the child. The gums must surround a significant part of the areola so that the sinuses are placed as deep as possible in the child's mouth.
- 'After breastfeeding the nipple must not be flattened or injured; breastfeeding must not hurt the mother. The correct position of the nipple in the baby's mouth is the only way to prevent soreness and damage to the surface of the nipple. A nursing mother needs a calm, considerate and stimulating environment. A breastfed baby is equipped with reflexes and their mutual coordination.
- On the first day, the child claims to drink 3-4 times, from the second day more often 8-20 times a day (i.e. every 2-3 hours).
- A sleeping or sick child should be woken up and put to the breast for 3-4 hours.
- Weight loss after childbirth usually does not exceed 10%, reflects the movement of water in the body and is not an indication for fluid administration; it will settle in about 1 week.
- A newborn usually urinates at birth and then within 24-48 hours.
- A sign of sufficient fluid intake from the 4th day is 6-8 light urine-soaked diapers.
- Stools - after the transition from milk, they are yellow, have a milky smell and can be very loose with a watery edge.
 - In the first weeks, the stool may be several times a day, but also once a week.
 - In the air (especially in an icteric newborn), the stool may have a greenish color.
 - Frequent green stool (with a flat weight curve at the same time) means an excess of lactose from the "front milk" (not a lack of it) - it happens if the mother breastfeeds too short and the baby does not have enough "hind" milk.
 - Hungry stools - small, infrequent, with mucus and brownish in color.
- so-called growth spurts - periods when the child suddenly requires more frequent breastfeeding - usually in the 3rd, 6th, 12th and 24th weeks.
 - If the mother is prepared for this situation, it is usually without problems.
- **Frequent mistake** - *giving tea* between feedings with the idea that the baby must also drink during feeding - this is an unnecessary and harmful habit. Giving a pacifier in the first weeks of life is equally unfavorable.^[22]

The vast majority of women are able to breastfeed, as evidenced by the data of the Institute for Health Information and Statistics (ÚZIS), when in 2006 more than 95% of children were breastfed when they left the maternity hospital - only a small percentage of them were supplemented. If breastfeeding fails, in most cases it is a matter of **bad breastfeeding technique** especially at the beginning, **premature administration of liquids and food other than breast milk**, **low self-confidence of the mother** that the child will be supported by breastfeeding or a combination of these reasons.^[14]

The frequency of breastfeeding is individual and should be guided by the needs and tastes of the child ("on demand"). A full-term newborn first reports breastfeeding after 2-3 hours. From the 4th day after birth, approx. 6-8 wet diapers per day are a reflection of a sufficient supply of fluids. The frequency of stools in breastfed children is very individual (several times a day to once a week). After birth, there is a postpartum weight loss, which should not exceed 10% of the birth weight and should be balanced within 2 weeks of age.^[15]

Breastfeeding problems

- **Obstacles to breastfeeding from the mother and child**:
 - from the mother's side: inflammation of the gland, sore nipples, inverted nipples,
 - on the part of the child: absence of the sucking reflex (premature, CNS impairment), congenital choanal atresia.
- **Painful engorgement of the breast** - is caused by the child's uneven emptying of the breast, poor suction technique, relief is provided by cold or ice compresses, reflex massage and gentle shaping of the flattened

nipple so that the child can latch on effectively...

- **Late onset of lactation** - babies drink a large amount of milk by the third day after birth, with some mothers, a sufficient amount does not begin to form until the 5th-6th day. day after birth.
 - It is necessary to support the mother's trust and exceptionally give fluids, sometimes even foreign pasteurized milk, with a spoon, beaker or even a probe attached to the nipple, but always after applying to the breast.
 - True hypogalactia is rare (in 3-4% of women).
- **Milk retention** - painful redness and stiffness of the breast (corresponds to the extent of the segment of the mammary gland and the catchment area of one outlet), is typically in the armpit, may be accompanied by fever and soreness. The essence is the blockage of the duct with cellular debris and dried milk. It is treated with ice packs, massage, antipyretics. It is not a reason to stop breastfeeding. It differs from mastitis in the precise delimitation of the inflammation and the rapid resolution.
- **Mastitis** - is rare in the first two weeks. It is treated with anti-staphylococcal ATB, possibly. antimycotics and antipyretics. It is not necessary to interrupt breastfeeding even during the infection - at the time of the onset, the newborn already shares the bacteremia with the mother, by interrupting breastfeeding the child will be deprived of the mother's Ig.
- **Ramps and injuries** - the result of bad breastfeeding technique, one bad touch is enough to cause damage. It is necessary to choose another location temporarily. The rash heals within a few days even without treatment.
- **Separation of the child from the mother'** - complicates milk production. The mother can express the baby's milk after 2-3 hours (of which at least 2 × at night). Freshly expressed milk can be stored in the refrigerator for 24 hours. If it needs to be stored longer, it must be frozen at −18 °C (lasts up to 3 months) - cells, Ig etc. are destroyed^[22]

Comparison of breast milk with formulas for artificial feeding

 For more information see *Artificial infant formula*.

The composition of breast milk is a guide for the production and composition of infant formulas (replacement 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 just 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.

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.^[19]

Content of essential nutrients in 1 liter of milk^[23]

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

Despite the best efforts of the producers of breast milk substitutes, '*formulas are in many respects not equivalent to breast milk*' and should only be used when necessary based on professional advice. According to the decree of the Ministry of Health, **the labeling of initial infant formula must include a notice expressing the preference of breastfeeding over infant formula products.**

Infant formula packaging must not contain images of babies or other images or claims that idealize the product. In accordance with the *International Code of Marketing of Breast Milk Substitutes*, health professionals must not allow the promotion of artificial infant formula products, pacifiers and baby bottles, the provision of samples or supplies of infant milk formula for free or at a discount to medical facilities.^[14]

“Child Friendly Hospital”

According to ÚZIS, 41% of children were breastfed at 6 months of age in 2006.^[14] According to data from the Lactation League from 2012, 65% of children were breastfed at 6 months of age; 33% of children were exclusively breastfed at 3 months and 17% at 6 months.^[19] This favorable trend, which we attribute to the support and promotion of breastfeeding in the Czech Republic, especially to the "Baby friendly hospital" initiative, because from the 1960s to the mid-1990s, the prevalence of breastfeeding at 6 months was between 12% and 14%. To earn this title, a midwife must complete the 10 Steps to Successful Breastfeeding, which are designed to help the mother initiate and fully develop breastfeeding. Part of the strategy of the "'Child Friendly Hospital'" initiative is:

- enable mothers to start breastfeeding within half an hour after giving birth,
- enable mothers to breastfeed without limiting the frequency and length of breastfeeding, not according to a set time schedule,
- enable mothers to stay with their newborns for 24 hours in the same room (rooming-in),

- show and teach the mother the correct breastfeeding technique,
- give liquids or additional food only in medically indicated cases with a spoon or a cup, not with a baby bottle, the use of which spoils the breastfeeding technique,
- do not use pacifiers, which also spoil the breastfeeding technique.

For the success of breastfeeding after leaving the maternity hospital, it is essential to follow the "correct breastfeeding technique", "breastfeed the child as needed", that is, as often and for as long as the child wants, if the child thrives on breastfeeding "exclusively until the end of 6 months. **The administration of other liquids or complementary foods displaces breast milk:** a child who has filled his stomach with e.g. tea does not suck the already produced milk from the breast, and since the amount of breast milk is formed on the basis of "demand", its production gradually decreases. ^[14]

Nutrition with donor breast milk

Breastfeeding is a natural and irreplaceable way of feeding a newborn and an infant. For example, in newborns with low birth weight, as in all other cases when breastfeeding is not possible, there is an alternative of feeding with donor breast milk. The collection, treatment and distribution of breast milk is provided by breast milk banks (or they are also referred to as collection centers if the operation is set up only for the needs of the own medical facility).

The health benefits of breastfeeding outweigh any risks. This means that there are very few situations that would be an absolute contraindication to breastfeeding. However, there are also documented cases of salmonellosis, listeriosis, infections caused by beta-hemolytic streptococci, the bacteria *Staphylococcus aureus* and other pathogenic agents, which most often manifest clinically as neonatal sepsis. Clinical nutrition with donor breast milk is subject to special rules: it is nutrition with a very specific type of "food", which in the past has already become a vehicle for several infections. Infections transmitted as part of medical or nursing care during a stay in a medical facility meet the criteria of nosocomial infections.

The basic preventive measure is the selection and education of women who decide to donate breast milk. The woman must be healthy, she should not permanently use any drugs or plant products with bioactive effects (phytopharmaceuticals, some dietary supplements), she should have a negative epidemiological history with regard to infections that can be transmitted through breast milk, and she must undergo appropriate internal and serological examination .

The practice of self-handling donor breast milk differs in many countries. Arguments in favor of using raw (ie unpasteurized) donor breast milk are based on the protective importance for the infant's immune system, because pasteurization reduces the bioactive effect of IgA, lactoferrin and lysozyme. For example, in Norway and Germany, bacteriological testing of breast milk is carried out for the total number of microorganisms (<https://www.vri.cz/index.php>) and selected pathogens (enterobacteria, *Staphylococcus aureus*, beta-hemolytic streptococci). It is reported that up to 30% of donated milk must be discarded due to non-compliance, but the microbiological criteria used are inconsistent. In Sweden, unpasteurized breast milk is reportedly shipped by 5 breast milk banks out of a total of 27.

In the Czech Republic, unpasteurized breast milk may only be used for one's own child (the milk must be consumed within 24 hours). In all other cases, breast milk must be pasteurized. The pasteurization mode requires a temperature of 62.5 degrees Celsius for 30 minutes. Immediately after pasteurization, breast milk must be cooled to a temperature of 4 degrees Celsius, or frozen at -18 degrees Celsius or below. The shelf life of chilled milk is 48 hours, and 3 months for frozen milk. Before use, breast milk must be heated in a water bath to a temperature of 37 degrees Celsius. Frozen milk must first be thawed under running cold water or by storing in a refrigerator at a temperature of 4 degrees Celsius until it is completely thawed.^{[24][25][26]}

Duration of breastfeeding and introduction of complementary foods

Breast milk production gradually increases after birth and peaks about 3-4 months after birth (corresponds to an average of about 750-850 ml/24 hours, respectively 500-1200 ml/24 hours). After the 4th to 6th month of the child's age, the intake of protein and energy per kilogram of body weight decreases, therefore it is advisable to introduce complementary foods. It is similar with the level of serum ferritin. anemia and low ferritin levels occur more frequently in exclusively breastfed infants at 6 months of age than in breastfed infants at 4-5 months of age. Iron deficiency leads to the development of irreversible long-term cognitive deficit. Iron stores are favorably affected by the delayed interruption of the umbilical cord and the mother's normal iron level during pregnancy.^[21]

Based on a systematic review conducted by the WHO in 2001, exclusive breastfeeding was recommended until 6 months of age.^{[27][28]} In 2008, a recommendation was published according to which it is advisable to introduce complementary foods (potential food allergens, i.e. including gluten) already between the 4th and 6th months of age, i.e. during the so-called .of a critical (immunological) development window, while simultaneously breastfeeding.^{[29][30][31][21]}

- Current WHO recommendations (<https://www.who.int/en/news-room/fact-sheets/detail/infant-and-young-child-feeding>)
- Current ESPGHAN Recommendation (<https://www.ncbi.nlm.nih.gov/pubmed/28027215>)

Breastfeeding history

Breast milk nutrition was a fundamental issue of life and death for infants until the beginning of the 20th century. With the impossibility of breastfeeding, the survival of the infant was exceptional and with severe consequences. The first attempts at artificial nutrition belonged to children whose chances of survival without breastfeeding were minimal. However, artificial feeding has become so widespread since then that in the second half of the 20th century it pushed natural breastfeeding into second place in most developed countries - it was actually "the largest population experiment without a control group". Today, the return to natural nutrition can be considered the greatest goal of population medicine.

Species differences of mammalian milk

- During the phylogeny of mammalian species, the composition of their milk also adapted to cover the needs of the young.

The kind	Doubling weight in days	Content in milk		
		Fats	Proteins	Lactose
Man	180	2.8	0.9	7
Horse	60	1.9	2.5	6.2
Cow	47	3.7	3.4	4.8
Deer	30	16.9	11.5	2.8
Goat	19	4.5	2.9	4.1
Sheep	10	7.4	5.5	4.8
Rat	6	15	3	2

- The indirect relationship between the content of lactose and fat is interesting - e.g. human milk has the most lactose and little fat.
 - Otherwise, for example, walrus milk does not contain lactose at all, but has 38% fat.
- From the point of view of transmission of immunoglobulins (Ig), mammals can be divided into three groups:
 - 1st group - *ruminants* - the supply of Ig is ensured only by colostrum (colostrum), mainly IgG (there is 100 × more of it than albumin);
 - 2nd group - *dogs, cats, mice, rats* - IgG via placenta and in colostrum dominate IgA;
 - 3rd group - *human, monkey, guinea pig, rabbit* - IgG gets through the placenta, there is secretory IgA in milk (mainly in colostrum and a few days after birth, then sIgA decreases).

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

External links

- Laktační liga (<http://www.kojeni.cz/>) • Working group of pediatric gastroenterology and nutrition ČPS JEP (<https://www.gastroped.cz/>) • newtoxnet/lactmed.htm Toxicology Data Network (<https://toxnet.nlm.nih.gov/>) • UNICEF (<https://www.unicef.org/>) • WHO (<http://www.who.int/en/>) • /technika-kojeni.html Kojeni.net (<http://www.kojeni.net>) • Breast milk vs. artificial nutrition at www.bio-life.cz (<http://www.bio-life.cz/clanky/deti-a-maminky/matenske-mleko-vs-umela-vyziva.html>)

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