Breastfeeding

Breastfeeding is a complex physiological process. It addition to providing nourishment for the newborn and nursling, it has many additional non-nutritional benefits for both the mother and the infant. Breast milk has a well-balance composition which enables easy digestion and absorption of nutrients. In full-term babies, it is advised to start the breastfeeding as soon as the circumstances would allow it. Exclusive breastfeeding is recommended for the first 6 months of baby life, in this period only vitamins D and K are supplemented (and the vitamin K is indicated only if it was after birth administered perorally or intravenously instead of intramuscularly). Allergologists recommend introducing non-milk based complementary foods at the end of 4 months during the so called “window of immunological tolerance” which refers to the period between 4 and 6 months. Introducing complementary foods before end of 4 months or after 6 months is associated with certain health risks, such as malnutrition, eating disorders, allergies and anaemia. If the baby is prospering, it is recommended to combine breastfeeding with complementary food for 2 years or even longer. Breastfeeding is contraindicated only in exceptional cases.[1][2][3]

The significance of breastfeeding

Breastfeeding is a complex physiological process, significant for both the mother and the infant. Exclusive breastfeeding for the period of at least 4 months has following advantages over baby formula:

- optimal composition which allows easy digestion and absorption of nutrients; composition and amount of breast milk changes to fit baby’s needs; it also provides digestive enzyme (milk lipase);
- immunological aspects: protection against bacterial and viral infections (especially respiratory and gastrointestinal); passive immunisation with IgA; immunological factors (hormones, growth factors, bifidus factor), which stimulate development of baby’s own defence system;
- formation of bond between the mother and the baby (*bonding*);[4]
- transport of non-nutritional factors from mother to the baby - breast milk hormones and growth factors;[4]
- preparing baby for the extrauterine nurture;[4]
- programming that influences baby’s health in the long-term perspective;[4]
- Benefits for the baby: lower incidence of middle ear infections, gastroenteritis, Necrotizing enterocolitis lower respiratory tract infections, lower incidence of allergies, sudden infant death syndrome and in older age lower incidence of obesity, DM type 1, high blood pressure, high cholesterol levels, higher IQ;
- Benefits for the mother: lower risk of DM type 2, lower incidence of breast and ovarian cancer; breastfeeding shortly after labour increases oxytocin1. levels which decreases after-birth blood loss and leads to quicker uterus involution; blocks menstruation and hence also further blood loss and premature successive pregnancy (but breastfeeding isn’t reliable anticonception method); women who breastfeed return to their former weight sooner and have lower risk of femoral neck fractures during the menopause. [1][3][5][6]

Since conducting randomized studies would be unethical, the above presented information was obtained from observational studies.[1]

Contraindications of breastfeeding

Absolute contraindication:

- foetal:
  - classic form of galactosemia with zero activity of gal-1-puridyltransferase in erythrocytes;
- maternal:
  - HIV/AIDS infection (but only in developed countries);
  - HTLV 1,2 infection.[1]

Partial contraindication:

- foetal:
  - phenylketonuria – depending on individual tolerance of phenylalanine;
  - other metabolic disorders – as consulted with metabolic disease centre;
- maternal:
  - drug abuse.[1]

Temporary contraindication:

- maternal:
  - herpes zoster, herpes simplex in the breast area – until the lesion disappears, the affected breast shouldn’t be used for breastfeeding (and the milk should be regularly pumped and discarded); breastfeeding could be done from the other breast;
  - cytomegalovirus – in preterm babies of seropositive mothers if risks outweigh benefits;
  - chicken pox presenting itself 5 days before labour and 2 days after labour – the mother should be isolated from the child until the blisters burst; the infant should be given varicella-zoster immunoglobulin; the infant can be given expressed breast milk from the mother;
  - active tuberculosis – the mother should be separated from the child until the treatment starts taking effect with the mother ceasing to be infectious; the infant should be vaccinated and administered

chemoprophylaxis; the infant can be given expressed breast milk from the mother;
- radioactive isotopes – radionuclides with short half-time should be preferred; the breastfeeding should be interrupted for the period five time as long as is the half-time;
- chemotherapy;
- some medications (the list is available on TOXNET (https://toxnet.nlm.nih.gov/newtoxnet/lactmed.htm)).[1]

Medications with absolute contraindication during breastfeeding:

- cytostatics, immunosuppressants, oestrogens (lower lactation), addictive substances (heroin, cocaine, amphetamine), alkaloids such as bromocriptine or ergotamine, lithium, gold salts, radioactive isotopes.[7]

No contraindication:

- maternal:
  - hepatitis A, B, C (but breastfeeding should be reconsidered if the HBV infection of the mother is acute, meaning she is positive for HBsAg and HBeAg but negative for anti-HBe)[7];
  - febrile state, viral infections, mastitis, vaccination, diseases of the gastrointestinal or urinal tract;
  - smoking – the mother is advised to stop smoking;
  - alcohol should be only consumed occasionally with 2-hour interval before the next feeding session.[1]

Physiology of lactation

Breast milk is produced in **epithelial cells of alveoli** of mammary gland. It is secreted into alveoli from where it flows through the small and large lactiferous ducts into the sinuses within areola which open to the tip of the nipple. Growth and differentiation of mammary gland and production of breast milk is under control of endocrine system.[8]

After the **placenta is expulsed** there is a release of substantial amount of **prolactin from adenohypophysis**which induced milk production during first few days after birth. The hormone prolactin has a key role in lactation. Lactation early after the birth stimulates development of **prolactin receptors in mammary gland**.. In contrast, postponed lactation leads to lower level of prolactin and consequently lower stimulation of prolactin receptors.[9]

Baby's **suckling** sends**nervous impulses from the breast into the neurohypophysis**which responds by **releasing oxytocin**. Under the influence of oxytocin, myoepithelial cells of the lactiferous ducts contracts which helps to move the milk from alveoli to the nipple (milk ejection reflex or let-down reflex). Initially, it's an unconditioned reflex which later changes into conditioned and can be blocked by anxiety and pain. [9]

Initially, lactation is controlled hormonally - colostrum production follows independently from suckling. Colostrum is dense, produced in low amount (4-14 ml at each feeding). During the next 48-96 hours, the production of milk significantly increases with suckling and demand (the amount of milk secreted). These processes are crucial for further continuation of lactation. After 1-2 weeks, the average milk production is 700-800ml/day (with great individual variability 450-1200 ml/day). At the end of each feedings session, there is about 100ml milk residuum in breasts. It appears that babies are capable of influencing milk production so that it would optimal for their growth. Hence, assessment of the amount of milk drunk is indicated only if weight gains are unsatisfactory.[9]

Milk is produced only if it gets discharged from breasts. The speed of milk production can vary between the breasts, if the length and suckling frequency varies. From that it can be concluded that in each breast there is a separate autocrine regulation of milk secretion through production of local factor (so called *feedback inhibitor of lactation*).[9]

Main principles of breastfeeding

Stimulating lactation in the maternity ward:

- breastfeeding should be encouraged without constraining its length or frequency – the babies should be breastfed according their appetite;
- the babies should be latched on to the breast at least 8-12x in 24-hour period (or even more often);
- both breasts should be used during each feeding session;
- 1. the signs that baby is prepared for the feeding: alertness, activity, mouth opening and searching for a finger; crying is late sign of hunger.[1]

Continuing lactation after leaving maternity ward:

- first PLDD exam should include the assessment of infant nutrition and breastfeeding efficacy based on the number of stools produced (which should be 3-6 a day in first 6 months after with a few-day-lasting absence of stool is possible), number of wet diapers produced (should be 6-8 a day). The act of breastfeeding should be observed and it should be checked for signs of icterus;
- one breast should be used exclusively for the whole feeding session
- healthy breastfed baby does not need any additional liquids, food or food supplements or additional milk source, except when it is indicated medically;
- in case when supplementary baby formulae are indicated they should be administered via an alternative path, e.g. through a probe attached to the breast, through a cup, spoon or through a breastfeeding kit;

- the cups and pacifiers should not be used – they spoil the suckling technique especially in first 6 weeks until it stabilizes;
- nursing cups should not be used regularly, only for flat or retracted nipples;
- after breastfeeding, milk should be expressed only if it is present in excess;
- the need for more frequent feeding should be considered for the growth spurt period (that means between 3 and 6 weeks and 3 and 6 months);
- the weight gain should be monitored: between 2 and 3 weeks, baby should reach its birth weight and then during first 6 months gain on average 125-200g a week (gain according to percentile graphs percentilových grafů (http://www.szu.cz/publikace/data/seznam-rustovych-grafu-ke-stazeni)).
- mother should eat healthy, she shouldn't smoke or drink alcohol, she shouldn't be losing weight rapidly (fat mobilisation can release toxic substances such as polychlorinated biphenyls, chlorinated hydrocarbons or heavy metals) [6]; to prevent allergy in the infant, mother is advised not to be on a diet;

Composition of the breast milk

Composition of the breast milk is tuned to the needs of the newborn. During the first days after birth, colostrum (the "first milk") is produced which is rich in **immunoglobulins** and has lower content of lactose. After few days, it changes onto mature milk. Calorific value of breast milk is around 67kcal/100ml. [3] The composition of breast milk – saccharides: 10g/100ml, fats: 5-7g/100ml, proteins: 1,5g/100mml [10]

Left: A sample of "foremilk" with higher water content which the infant sucks at the beginning of the feeding, Right: A sample of "hindmilk" with higher content of nutrients which the infant sucks at the end from almost empty breast.

Colostrum (first milk)

- Produced during the first week
- Contains **more proteins**, less fats and saccharides.
- Rich in macrophages, lymphocytes, granulocytes and secretory IgA.
- Has lower energy content, only about 56 kcal/100ml.[8]
- dense, cream yellow liquid.
- Its well-adjusted to the needs of early newborn– the kidneys aren't yet able to excrete liquid overload; low production of lactose in the gut; vitamins A a E protect against oxidative stress, [vitamin K]] decreases the risk of haemorrhages.

Transitional milk

- Produced between 2 and 3 weeks after birth.
- Contains less proteins, but more fats and saccharides.[8]

Mature breast milk

- Produced after 3 weeks since birth.[8]
- Breast milk doesn't have stable composition. There are significant fluctuations not only during the whole lactation period but during each day and even each feeding session.
- Energy content is around 60-70 kcal/100ml.[4]

Proteins

- Human breast milk contains around **asi 1 g bílkovin na 100 ml** which is quite little.
  - content of proteins in mammalian breast milk is correlated with the rate of growth of the youngling. In humans, postnatal growth of infants is very slow compared to the other mammals and hence the content of proteins in breast milk is low. In contrast, the cow milk contains 3,5g of proteins per 100ml.
- Most proteins are contained within **whey**within whey and casein. Whey represents around 60% of all proteins in human milk and is extremely significant for nutrition, since it contains many **essential amino acids**.[4] Poměr syrovátka : kasein je 70 : 30.[8]
  - In contrast, cow milk (CM) is dominated by casein and whey represents only about 20% of proteins. In the low pH, casein can coagulate (for instance newborn's stomach) which results in formation of lumps (the "curd")
- Whey of the human milk (HM) is mostly made of **α-lactalbumin**, followed by **lactoferrin**.
  - In the whey of cow milk, the main protein is β-lactalbumin which isn't present at all in human milk and hence is potentially antigenic for infants, cow milk does contain α-lactalbumin, lactoferrin is also present, but only in small amounts.
- HM contains two times **more cysteine**1. than CM and the ratio methionine/cysteine is in HM 7x lower than in CM. Cystathionase, an enzyme which converts methionine into cysteine, is expressed only later on, hence for the newborn cysteine would qualify as essential amino acid.
- HM contains relatively little **tyrosine and phenylalanine** – probably because the infant can't metabolise these amino acids well.
- There is a **high content of non-protein nitrogen** (about 25% in HM, only 6% in CM) – free amino acids, urea, creatinine, creatine, uric acid and ammonia. From nutritional point of view, it is necessary to include free amino acids to protein count. For other non-protein sources of nitrogen, it is not clear whether they have any nutritional value.
- HM contains lot more **taurine** (free amino acid) than CM. The shortage of taurine leads to dysfunction of eye

retina.
- At the beginning of lactation, there is a lot more protein in HM than there is in mature HM. The decreasing amount of protein could reflect decreasing demand in the newborn or it could be only an aftereffect of mammary gland maturation. [4][8]

Fats

- The content of fats **varies greatly** among mothers. Usually, at the beginning of the lactation (in the first 1-2 weeks) it increases and then later decreases. There is a twofold (four to fivefold according to some sources) increase in fat concentration during the breastfeeding session. [4],[8].
- Fats are the main **energy source**. They cover more than 50% or the newborn's energy need.[8]
- They are source of essential fatty acids (linoleic acid, α-linolenic, arachidonic, docosahexaenoic) and fat soluble vitamins. Arachidonic acid and docosahexaenoic acid are very important for development of CNS and retina.
- The main source of lipids are **triglycerides** (90[8] to 98%)[4]).
- 42% of fatty acids are saturated, 58% unsaturated.[8]
- The percentage content of different fatty acids relates closely to **mother's diet** (fishes and sea food have high content of polyunsaturated fatty acids with long chain, especially docosahexaenoic acid (DHA); vegetarianism – more fatty acids than in mixed diet).
- HM contains lipase which enables easier digestion of lipids.
- HM and CM have similar content of fats; the difference lies in percentage contents for different fatty acids. HM contains more unsaturated and essential fatty acids than CM. In contrast to CM, fatty acids are esterified with glycerol on the first position, allowing easier absorption. HM contains 2-3 times more cholesterol than CM.[4]
- MM obsahuje 2-3krát více cholesterolu než KM. [8]
- Humans and gorillas are the only mammals which contain lipase in the milk (and hence have the enzyme as well as the substrate), because the function of pankreatic lipase isn't sufficient yet.
    - Lipase is activated by Bile acids in the small intestine, je thermolabile, it denatures after boiling.

Saccharides

- HM contain 7 g of lactose per 100ml (Cm 4,7g/100ml).
- **Lactose** enables easier absorption of calcium in the intestine, lowers pH of the stool, supports growth of Bifidobacteria and Lactobacilli of gut microflora; they restrict growth of E. coli.
- **Galactose** is a monosaccharide contained within lactose. It is important for brain growth and calcium resorption.
- **Oligosaccharides** are complex saccharides structures bounded at lactose, often containing fructose and sialic acid. After lactose and fats, they comprise 3 biggest part of breast milk (and they amount in colostrum is doubled). They have **prebiotic effect** – they support growth of Bifidobacteria.1. . They have similar structure as receptors of epithelial cells, they bind bacteria, bacterial toxins and viruses. They influence adhesion of circulating leucocytes and endothelial cells and inhibits pathogenicity of Campylobacter jejuni, enteropathogenic E. coli, Streptococcus pneumoniae and Vibrio cholera. They increase weight and number of stools. In CM oligosaccharides are present only in negligible amounts.
- In exclusively breastfed newborns, 90% of gut microflora is composed of Lactobacilli and Bifidobacteria. Gut microflora influences the development of infant's immune system.[8][4]
    - The growth of lactobacilli is influence by different sugar from human milk, by so called "bifidus factor", an oligosaccharide containing N-acetylglucosamin – it isn't present in cow milk.
    - → Infants nursed by modified cow milk are colonised by coliform and putrefactive microflora and have lower stool pH.

Vitamins

- Vitamin A – its amount is significant higher in human milk than in cow milk (especially in colostrum).
- Vitamin K – its amount is high in colostrum but then drops – as its starts to be produced by the bacteria in the gut. After the birth, every full-term newborn gets 1 mg i-m- of vitamin K for prevention of bleeding due to lack of vitamin K. If vitamin K was administered through mouth it must be supplemented as 1 mg/ week until 12 weeks.[11]
- Vitamin D – its content in human milk is very low. Infants and children fed with baby formula are since 2 weeks supplemented vitamin D (cholecalciferol) as 500IU (one drop) daily through the course of first year of life and then during the winter months of 2 years.[11]
- The content of water soluble vitamins fluctuates with mother's diet, but usually their amount is sufficient.

Minerals

- The HM contains significantly less essential chemical elements (K, CL, Ca, P, NA, Mg) than CM. In CM, minerals and proteins burden kidneys with overload of water-soluble substance.
- The HM has initially significantly higher content of sodium (up to 10x more) than mature HM. [4]
- Calcium (Ca) is easier to absorb - its ratio is better than that of phosphorus (2:1).
    - High concentration of phosphates in cow milk leas to their preferential resorption and tendency to hypocalcaemia.
    - In addition, unresorbed Ca combines with FFA to form soaps which interfere with fat absorption and in extreme cases can lead to gut perforation.

In the first six months, breast milk offers enough calcium, then it needs to be supplemented from other sources (white yogurt). [11]

Trace elements

- HM and CM differ in percentage content of different trace elements (Zn, Fe, I, Cu, Mn) and in terms of their bioavailability. For instance, HM has less zinc and more copper. Iron and other minerals have higher bioavailability in HM.
- Colostrum contains higher amount of copper, iron and zinc than mature HM.[4]
- Zinc is a cofactor of 78 metaloenzymes participating in immunity and metabolism.

Iron

- HM contains very low amount of iron, but get gets absorbed extremely efficiently (up to 80% compared to 4-6% in fortified formulas.)
- Full-term newborn has in the body 250-300 mg of iron (75mg/kg of body weight), which covers their daily need during first 4 to 6 months. After that the demand for iron increases significantly (to around 0,7-0,9 mg/day – which is a lot when related to body size). During the first year, infants almost double their iron demand (and triple their weight).
- Hypotrophic newborn has low reserves of iron at birth and therefore would experience iron defect sooner. Besides the birth weight, the initial iron store is influenced also by other factors, such as the iron store of mother during pregnancy or placental transfusion at birth (delayed cutting of umbilical cord increases baby's iron store).
- Iron deficiency anaemia is very common in childhood, usually asymptomatic
- When introducing complementary food, it's important to give foods rich in iron (for instance red meat or food fortified with iron.) [4]
- Iron – z mateřského mléka se vstřebává až 70 % železa (z kravského 30 %).
  - ke vstřebávání je dobrá i kyselost prostředí.
  - Laktoferin v mateřském mléce nese železo a brání jeho vychytávání bakteriemi.
  - Na železo nepůsobí dobře včasné podávání nemléčných doplňků (např. hruška jej chelatuje).

Fluorine

In human milk, the content of fluorine is low and hence breastfeeding mothers are advised to take 200microg of iodine daily if they don't consume at least two serving of sea fish per day. [11]

Other components of milk

- Breast milks contains lot of substances which regulate growth and development of the baby.
- Mammary gland serves as a polyfunctional endocrine organ (affecting both mother and the child).

Immunological aspects of breastfeeding

Human milk contains immunoglobulins out of which most important is *secretory IgA'* which reaches its highest concentration in first days after birth. Secretory IgA is very resistant against low pH and action of proteolytic enzymes and can be detected in the stool od breastfed babies. It has protective effect, but probably only in gastrointestinal system and respiratory tract.

Besides IgA, there is a low concentration of IgG, but it's not certain whether it gets absorbed. In human milk, various kinds of antibodies against viruses, bacteria and their toxins were found, but their significance and degree of resorption remains unclear. HM also contains low concentration of complement components, but their significance is unclear too.

HM is a rich source of *lysozyme*, which in vitro (together with IgA) includes lysis of E. coli and some salmonellas, but its effect in vivo was not yet confirmed.

Lactoferrin, an iron binding protein, lowers the level of free iron which is a growth factor for pathogenic organisms. It has bacteriostatic and bactericidal effect in vitro, but its effect in vivo remains unclear. The level of lactoferrin increases significantly throughout the lactation which means it would potential serve as a growth factor. [12]

- Mammary gland is a very powerful immune organ.
- Human colostrum contains $1–3 \times 10^6$ leucocytes.
  - 80–90 % are macrophages filled by phagocytised lipids; they phagocytise yeast and bacteria.
  - 10% are lymphocytes, half of that B cells, rest T-cells
- The effect of lactoferrin– competitive binding of Fe (Fe is a growth and pathogenic factor in majority of the bacteria).
- Lysozyme – has a direct bactericidal effect, it is practically absent in cow milk.
- Secretory IgA - key factor of gut protection againstviruses a bacteria.
  - *Homing phenomenon* – colostrum IgA are specifically targeted against microbes of gut microflora of mother
  - Microbes in GIT of mother stimulate lymphocytes in GALT which then travel to mammary gland.

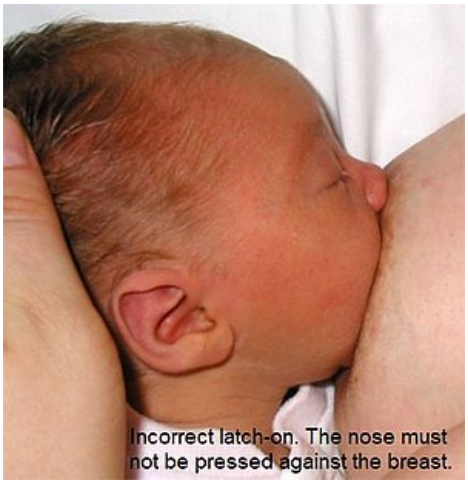
Medication and breastfeeding

Medications get transferred to the breast milk based on their physical and chemical properties.[3]

- Most medication get to the breast milk only in low amount.
- Even though some medication exert influence on the baby, benefits of breastfeeding usually outweigh the risks.
- **Medication contraindicated during breastfeeding**: cytostatics, radiopharmaceuticals, lithium, thyreostatics, lithium, alkaloids.
- **Partially contraindicated** (the effect on the baby is possible only with its taken on long-term basis in high doses): sulfonamides, antibiotics (chloramfenikol), hormony (estrogens), diuretics, antiepileptics a sedatives.
- Completely safe medications (overwhelming majority): bronchodilatators, vitamins, iron, antihistamines, digoxin, insulin, analgesics – paracetamol, salicylates.
- **Alcohol** – regular usage in higher doses can cause non-prospering
- **Caffeine** – moderate coffee drinking doesn't harm the baby
  - Excessive amount causes restlessness and sleep disturbances
- **Nicotine** – the amount of less than 5 cigarettes a day isn't directly harmful, but the babies often refuse to latch on and they are restless; the mother should smoke after the breastfeeding.
- **Drugs** – marijuana, cocaine, heroin – they are contraindicated and they lower prolactin level[13]

Breastfeeding technique

Correct breastfeeding technique lies in correct position and correct latch-on. In the **correct position**, mother supports all weight of the baby, keeping them close with their belly turned towards her ("tummy-to-mummy position). When the baby is **latched on correctly**, their mouth is wide opened and their lower lip is curled outwards, chin touches breast and the outer part of areola is more visible over than under mouth. After a brief period of quick suckling moves, the suckling slows down and baby's swallowing turns audible – those are the signs of **effective suckling**When the latch is done correctly, baby's gums compress areola, but not nipple which would result in pain and lead to nipple damage. Mechanism of suckling from the bottle is different to suckling from breast. Hence, the use of bottles is not advised for the breastfed babies as it could confuse them. If the baby needs other liquid than breast milk, it should be given via cup or spoon.[6]


Incorrect latch-on. The nose must not be pressed against the breast.

- **Breastfeeding position** – initially, mother breastfeeds in lying position, then later in sitting position. Mother and baby are lying on their sides next to one another (belly-to-belly).
- Baby's mouth is at the level of the nipple. Mother is bend so that her abdomen doesn't intercept her in having the baby close to her. During breastfeeding, baby's nose and chin must touch the breast. Mother pulls the baby towards her, not herself towards the baby. The gums of the baby must enclose big part of the areola, so that the sinuses would be positioned deeply in baby's mouth.
- **During the breastfeeding** nipple can't be neither flattened nor injured; breastfeeding must not be painful. Correct position of the nipple inside baby's mouth is the only way how to prevent the damage of the nipple surface. During breastfeeding session, the mother needs a peaceful, sympathetic and stimulating environment. Breastfed baby is equipped with reflexes which are mutually coordinated.
- On the first day baby asks for feeding 3-4x, since the day two 8-20x a day (every 2-3 hours)
- **Sleepy or sick** baby should be woken up every 3-4 hours to be latched on to the breast.
- Weight loss after birth doesn't usually surpass 10%; it reflects transport of water within the body and doesn't serve as indication for administering liquids; it should be re-stabilised in one week's time.
- Newborn usually urinates at birth and then till 24-48h later.
- A sign of adequate liquid intake is 6-8 light urine-soaked diapers since day 4.
- Stool – since the transition from meconium, it is yellow with smell reminiscing sour milk and can be loose with watery edge
  - In the first week, the frequency of stool can range from multiple times per day to one per week.
  - After exposure to air newborn's stool can attain greenish colour (this is especially true for icteric neonate)
  - Frequent green stool (accompanied by flat growth curve) can mean surplus of lactose z „předního mléka" from the "foremilk" (not its deficiency) – it happens if the mother breastfeeds too shortly and hence baby doesn't have enough of the "backmilk".
  - Growth spurts are periods in which baby requires more often feeding – usually during the week 3, 6, 12 and 24.
  - If mother is prepared, complications are rare.
- **Common mistake** – **giving tea** between feeding sessions due to belief that baby needs additional liquids, it's a useless and harmful practice. Another non-recommended practice is **using pacifier** in first weeks of life.[13]

Clear majority of woman is capable of breastfeeding, a fact that is supported by data from the Institute of Health Information and Statistics of the Czech Republic (ÚZIS). In 2006 more than 95% of infants were breastfed at the time of discharge from hospital – only small minority of babies were fed with formula. The most common reason of breastfeeding failure is **bad technique** (especially at the beginning), **premature introducing of non-milk based foods and liquids**, mother's disbelief that the breastfeeding would suffice to feed the baby; combination of the stated. [6]

Frequency of breastfeeding is individual and should be adjusted to baby's needs and tastes (*on demand*). Full-term newborn asks for feeding after 2-3 hours. Since the day 4, adequate liquid intake is reflected in producing 6-8 well-soaked diapers per day. Frequency of stool is highly individual (ranging from multiple times a day to 1x week). Baby experiences after-birth weight loss, which should, however, not surpass 10% of birth weight and should be gained back until 2 weeks.[3]

Breastfeeding problems

- **Maternal and foetal breastfeeding hindrances**:
  - maternal: glandular inflammation, breast rhagades, inverted nipple
  - absence of suck reflex (preterm, CNS defect) choanal atresia.
- **Breast engorgement** – caused by oversupply milk as result of baby not emptying the breast or bad breastfeeding technique. Relief is achieved by cold compress, massage and careful reforming of flattened nipple so that baby could latch on correctly…
- **Delayed milk production** – in first three days, neonates drink lot of milk, but some mother would start to produce enough milk only after day 5-6 since birth.
  - The confidence of the mother should be supported. In rare cases, additional liquids or milk source should be given via spoon, cup or probe attached to the breast, but always after putting baby to the breast
  - True hypogalactia is rare (in 3-4% of females)
- **Milk cysts** – a condition in which one portion of the breast becomes rigid and swollen due to milk retention in the ductal system. It's typically located in the axilla and can be accompanied by fevers and pains. It's treated by cold compresses, massage and antipyretics. There is no need for stopping the breastfeeding. Milk cyst can be differentiated from mastitis by the fact that in milk cyst the inflammation is well-bordered and resolves quickly.
- **Mastitis** – rare in first two weeks. It is treated with anti-staphylococcal antibiotics or possibly with antimycotics a antipyretics. Again, there is no need to discontinue lactation – at the time of mastitis presentation, neonate is already infected and breast milk at least provides maternal IgGs.
- **Rhagades and injuries** – result of bad breastfeeding technique; one incorrect latch suffices to induce injury. It's necessary to later the breastfeeding position. The rhagade should heal on its own in few days even without treatment.
- **Separation of mother from child** – interferes with milk production. Mother can express milk for the baby in 2-3 hour intervals (one of which at least 2x during night). Freshly expressed milk can be stored in the fridge for up to 24 hours. If there is a need to store milk for longer, it needs to be cooled to -18°C (that way it lasts for up to 3 months) – but Ig and cells get destroyed.[13]

Comparing breast milk with baby formula

Baby formulae try to mimic of breast milk as much as possible, but even if there was theoretically no difference in composition, there would be still differences in bioavailability and resulting metabolic effect. Therefore, comparing composition doesn't suffice, it is necessary to assess overall effect on development, biochemical values and organ systems function.

The main substrate for production of formulae is cow milk; exceptionally milks of different mammals or plant proteins. Cow milk protein must be adapted – the ratio between whey and casein must be changed from 2:8 to 1:1 or even higher. [14]

The content of nutrients in 1 litre of milk [15]

	Human milk	**Cow milk**
Proteins (g)	10	33
Fats (g)	39	38
Saccharides (g)	72	47
Energy (kcal)	680	680

Despites the efforts of formula producers, baby formulae do not measure up to breast milk in multiple regardsand therefore should be used if necessary (based on medical advice). Czech ministry of health has issued an edict according to which the baby formulae packages must portray a note that breastfeeding is a preferred option to baby formulae. The package of baby formulae must not contain pictures of babies or statements that would idealise the product. In agreement with The International Code of Marketing of Breast-milk Substitutes the physicians must not encourage propagation of baby formulae, pacifiers or baby bottles; they must not offer free samples breast-milk substitutes or provide a discount for a pharmacy.[6]

"Baby friendly hospital"

Based on ÚZIS data, in 2006 41% of kids were breastfed at 6 months of age.[6]. According to data of Lactation League from 2012, 65% of kids were breastfed in 6 months, 33% of kids were exclusively breastfed in 3 months and 17% were exclusively breastfed in 6 months. [1] This favourable trend is attributed to propagation of breastfeeding in Czech Republic, especially to the initiative "Baby friendly hospital", because between 60s to mid

90s of the last century, the prevalence of breastfeeding fluctuated between 12%-14%. To attain the title baby friendly hospital, the hospital must comply with 10 steps that are designed to help the mother to start and develop successful breastfeeding. The strategy of the initiative “Baby friendly hospital” includes following points:

- Allowing mother to start breastfeeding until half an hour after labour
- Allowing mother of breastfeed, without constraining length and frequency of feeding, no fixed time plan should be ushered
- Allowing a 24-hour stay of mother with the infant in the same room (rooming in)
- Showing and teaching mother the right technique of breastfeeding
- Giving liquids or breast-milk substitutes only in indicated cases via spoon or cup, but not via baby bottle, because its use spoils the suckling technique
- Discouraging use of pacifiers which spoil suckling technique

To ensure the success of breastfeeding after leaving hospital it is necessary to adhere to **correct breastfeeding technique**, **breastfeed the baby according to their needs**(which means as often and for as long as they want) and if the kid is prospering breastfeed **exclusively until 6 months.** Other liquids or supplementary foods interfere with breastfeeding cycle – after filling their stomach with tea or something else, babies wouldn’t suck out as much milk as they would normally and hence less milk would be produced in the next cycle (reacting to decreased demand).[6]

Supplementing with the donor breast milk

Breastfeeding is a natural and irreplaceable source of infant’s nourishment. In newborns with low birth weight and other cases in which breastfeeding is not possible, an alternative exists in form of donor breast milk. Acquisition, processing and distribution of donor breast milk is arranged by Human Milk Banks.

Medical benefits outweigh the risks. (If we are talking about the limited number of situation in which breastfeeding is strictly contraindicated.) While working with donor breast milk special code must be respected, since in the past this special type of “food supplement” had become vehicle of multiple infections. There are documented cases of cases of salmonellosis, listerioses, infections caused by beta-haemolytic streptococci, by *Staphylococcus aureus*and other pathological agents – these infections commonly manifest as neonatal sepsis If they are acquired during the in the health-care facility, they would classify as nosocomial infection.

The most basic preventive measure is careful selection and education of women who decide to donate breast milk. The woman must be healthy, should not take any medications or plant-based products with bioactive effects (phytopharmaceuticals, some dietary supplements), should have negative anamnesis of infections that could be transmitted via breast milk and must undergo clinical examination and serological tests.

> The way how donor breast milk is processed can differ in different countries. Arguments that speak for usage of unpasteurised donor breast milk stress the fact that pasteurisation lowers bioactivity IgA, lactoferrin and lysozyme, hence disabling their positive effect on infant’s immunity. In Norway and Germany, the milk is tested for overall number of microorganism as well as for several selected pathogens (enterobacteria, Staphylococcus aureus, beta-haemolytic streptococci). It’s reported that up to 30% of the donor milk must be discarded because it doesn’t meet the conditions. Nevertheless, the conditions aren’t uniform. In Sweden, only 5 out of 27 milk banks expend unpasteurised milk.

In Czech Republic, unpasteurised breast milk can’t be donated. Expressed milk assembled for baby’s personal use must be used up within 24-hour period. In all other cases the milk must be pasteurised. Pasteurisation regime requires keeping the temperature on 62,5°C for the duration of 30 minutes. Right after pasteurisation, breast milk must be cooled down to -18°C or lower. Milk that was cooled down must be used within 48 hours, milk that was frozen within three months. Before using, the milk must be warmed up in a water bath to 37°C. Frozen milk must first be defrosted through exposing it to stream of cold water or by placing it in the fridge (4°C) until it gets completely defrosted. [16][17][18]

Length of breastfeeding and introducing complementary foods

Production of breast milk gradually increases after birth and peaks after 3-4 months (on average 750-850ml/day, or better 500-1200 ml/day). In 4 to 6 months, baby doesn’t no longer receives enough proteins and energy in ratio to his body weight, so complementary foods should be introduced. Similar applies for level of serum ferritin – hence infants exclusively breastfed in 6 months are at higher risk of anaemia than babies breastfed up to 4-5 months. Iron deficiency leads to irreversible long-term cognitive defects. The stores of iron are positively influenced by delayed umbilical cord cutting and normal level of iron in mother during pregnancy.[12]

Based on review conducted by WHO in 2001, exclusive breastfeeding is recommended only up to 6 months of age. [19][20][21] In 2008 new recommendation was issued which states that complementary foods (along with potential antigens such as gluten) should be introduced between 4 and 6 months, during the window of immunological tolerance. [22][23][24][12]

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

History of breastfeeding

Until the beginning of 20th century breastfeeding was a question of life and death for infants. When breastfeeding was not possible, the survival was rare and with grave consequences. First attempts to create breast milk substitutes were done on the kids with minimal chance at being successfully breastfed. Nevertheless, breast milk substitutes grew in popularity and in developed countries became used even more often than normal breastfeeding – “the biggest ever population experiment conducted without control group”. Returning to breastfeeding can be credited as biggest goal of today’s population medicine.

Differences in mammalian breast milks

- During the phylogenesis of mammalian species, the composition of breast milk evolved so that it would better meet need of younglings.

Species	Doubling weight in days	Content in milk		
		Fats	Proteins	Lactose
Human	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

- There is an interesting indirect relationship between lactose content and fats – for instance human breast milk has most lactose and least fats.
  - In contrast, walrus’s milk contains no lactose at all but has 38% of fat.
- Based on the Ig transmission, mammals can be divided to three groups:
  - Group 1 – *ruminants* – for which Ig is only contained with meconium (mostly IgG – there is 100× more IgG than albumin);
  - Group 2 – *dogs, cats, mice and rats* – transmission of IgG trough placenta; meconium is dominated by IgA;
  - Group 3 – *humans, monkeys, Guinea pigs, rabbit* – IgG through placenta; secretory IgA in milk (higher content meconium, then its amount drops).

Sources

Related articles

- Child nutrition: Newborn nutrition • Breast-feeding • Bottled water • Artificial nutrition of the infant • Toddler nutrition • Recommendations for infant feeding 2011
- Nutritional recommendations: Dietary Guidelines for Population • Nutritional epidemiology • Lactation • Factors affecting nutritional needs • Nutritional epidemiology
- Alternative nutrition (1. LF, NT) • Enteral nutrition (pediatrics) • Nutrition Support Therapy • Nutritional support
- Food compostion: Carbohydrates in Human Nutrition • Protein in Human Nutrition • Lipids in Human Nutrition • Minerals in Human Nutrition • Trace Elements in Human Nutrition • Vitamins • Microorganisms in food • Food Contaminants
- Malnutrition • Assessment of nutritional status • Chronic eating disorders • Food allergies • Epidemiology of food allergies • Cow's milk protein allergy • Obesity (Pediatrics) • Low birth weight newborns • Growth restriction of the fetus

External sources

- Laktační liga (http://www.kojeni.cz/) • Pracovní skupina dětské gastroenterologie a výživy ČPS JEP (https://www.gastroped.cz/) • Toxicology Data Network (https://toxnet.nlm.nih.gov/newtoxnet/lactmed.htm) • UNICEF (https://www.unicef.org/) • WHO (http://www.who.int/en/) • Kojeni.net (http://www.kojeni.net/technika-kojeni.html) • Mateřské mléko vs. umělá výživa na www.bio-life.cz (http://www.bio-life.cz/clanky/deti-a-maminky/materske-mleko-vs-umela-vyziva.html)

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