

## THE COMPOSITION OF BREAST MILK AND THE IMPACT OF MATERNAL LIFE FACTORS ON CHILDREN'S HEALTH

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**Abstract:** Breast milk is the most natural and perfect source of nutrition for a newborn. It is enriched with numerous macro- and microelements, as well as biologically active components that play a decisive role in the infant's growth, development, and immune system formation. This article provides a detailed review of the chemical composition of breast milk, including macronutrients, vitamins, minerals, enzymes, immunomodulatory substances, and growth factors. Additionally, it analyzes how maternal lifestyle factors (diet, physical activity, environmental conditions, smoking, and others) influence the composition of breast milk. This information deepens the understanding of the importance of breastfeeding in infant care.

**Keywords:** Breast milk, composition, macronutrients, microelements, biologically active substances, maternal lifestyle, child health, immunity, growth factors.

### Introduction

Breast milk is a uniquely adapted and specialized food source for newborns. It is sterile and free of cost. Breastfeeding supports neural and psychological development. It also protects maternal health by preventing mastitis, oncological diseases of the mammary glands, uterus, and ovaries. Moreover, breast milk helps prevent purulent-septic infections. Breast milk not only satiates the infant but also contains numerous biologically active substances essential for strengthening the immune system and supporting growth and developmental processes. The composition of breast milk varies continuously depending on the mother's physiological condition, dietary habits, lifestyle, environmental factors, and genetic background. Comprehensive study of

breast milk composition is crucial for improving child health and ensuring optimal breastfeeding practices for newborns. According to the World Health Organization, infants should be exclusively breastfed for the first six months of life [5].

### **Chemical Composition of Breast Milk**

Breast milk consists mainly of three macronutrients: water, proteins, and fats. Additionally, it contains carbohydrates, primarily lactose. Approximately 87% of breast milk is water, which is essential for maintaining the infant's fluid balance [1]. Water content varies with lactation stages; for example, colostrum contains slightly less water than mature milk.

**Proteins:** The protein content in breast milk ranges between 0.8–1.0%, but its biological quality and composition are very high. Proteins mainly include casein, lactoferrin, immunoglobulins (IgA, IgG, IgM), enzymes, and growth factors. Casein serves as a nutrient source, while lactoferrin and immunoglobulins provide immune protection [4]. Casein accounts for 20–45% of milk proteins, is easily digestible, and supplies essential amino acids. Lactalbumin and lactoferrin possess antibacterial properties and enhance iron absorption.

**Immunoglobulins:** These antibodies protect the infant from infectious diseases.

**Fats:** Lipids make up approximately 3.5–4% of breast milk. They mainly consist of triglycerides, including a complex mixture of saturated and unsaturated fatty acids [3]. Saturated fatty acids comprise 30–50%, while the remainder is unsaturated, including omega-3 and omega-6 fatty acids. DHA (docosahexaenoic acid) and EPA (eicosapentaenoic acid) are crucial for neural and visual development. The fatty acid composition depends on maternal diet and genetics, influencing infant metabolism and brain development.

**Carbohydrates:** Lactose is the principal carbohydrate in breast milk, accounting for about 6.7%. It serves as an energy source and promotes the growth of beneficial gut microbiota. Breast milk is also rich in micronutrients (vitamins and minerals), whose amounts and bioavailability are critical for infant health.

**Vitamins:** Both water-soluble (B-complex, vitamin C) and fat-soluble vitamins (A, D, E, K) are present. Vitamin A supports eye health and immunity [2]. Vitamin D is important for bone development, though its amount in breast milk may be limited, often requiring supplementation. Vitamin E protects cells from oxidative damage, while vitamin K is essential for blood clotting.

**Minerals:** Breast milk contains iron, calcium, magnesium, phosphorus, potassium, selenium, and others. Although iron levels are low, lactoferrin enhances its absorption. Calcium and phosphorus contribute to bone and tooth development. Selenium acts as an antioxidant. Breast milk also contains various biologically active components involved in immunity, gut flora regulation, and growth stimulation. **Immunoglobulins:** Secretory IgA primarily protects the infant's digestive system from pathogenic microorganisms. **Lactoperoxidase and Lysozyme:** Enzymes with antibacterial effects. **Growth Factors:** Insulin-like growth factor-1 (IGF-1), epidermal growth factor (EGF), and others promote tissue development. **Oxytocin and Prolactin:** Regulate milk production in the mother. **Prebiotics:** Oligosaccharides that serve as nutrients for beneficial bacteria.

### **Impact of Maternal Lifestyle Factors on Breast Milk Composition**

Maternal nutrition quality directly influences the fat and vitamin content of breast milk. Deficiencies in dietary omega-3 fatty acids, vitamins (A, D, E, C), and minerals (iron, iodine, selenium) affect their concentrations in milk. For instance, consumption of fish and nuts increases DHA levels, which supports infant nervous system development. Deficiencies during pregnancy and lactation can lead to rickets, anemia, and immune suppression in infants.

**Maternal Body Mass Index (BMI) and Metabolic Status:** Obesity and elevated BMI are associated with increased saturated fatty acids and decreased beneficial omega-3 fatty acids in breast milk, potentially impairing infant metabolic health and cognitive development.

**Diabetes and metabolic disorders also reduce milk quality. Smoking:** Smoking lowers immunoprotein levels (osteopontin, lactoferrin) and transfers toxic substances into breast milk.

**Alcohol:** Alcohol consumption decreases milk production and may cause growth problems in infants.

**Stress and Environmental Factors:** Psychological stress can reduce milk production. Environmental pollution and toxins may pass into breast milk and harm the infant.

### **Effects of Breast Milk Composition on Child Health**

Breast milk supports infant growth, development, and immune defenses. Its immunoglobulins protect against infectious diseases; fatty acids support brain and eye development; proteins ensure proper immune function. Vitamins and minerals improve bone and blood health. The natural and adapted composition of breast milk protects infants from allergies, gastrointestinal disorders, and chronic diseases later in life.

### **Formulas for Calculating Daily Breast Milk Volume for Infants**

Zaytseva's formula (used for the first 10 days):

Daily milk volume (ml) = 2% of body weight  $\times$  infant age in days (p).

Finkelshteyn's formula (for the first 10 days):

$p \times 70$  (if birth weight < 3200 g);

$p \times 80$  (if birth weight > 3200 g).

### **Volume method (Geybner-Cherni)**

For infants aged 2–6 weeks, milk intake should be 1/5 of body weight;

6 weeks to 4 months — 1/6;

4–6 months — 1/7;

6–9 months — 1/8.

At 1 year, daily milk volume should not exceed 1000–1100 ml.

Example: A 2-month-old infant weighing 4800 g should consume approximately 800 ml of milk daily ( $4800 \div 6 = 800$  ml).

### **Caloric (energy) method**

Energy requirement per kg of body weight:

1–3 months: 120 kcal/kg;

3–6 months: 115 kcal/kg;

6–9 months: 110 kcal/kg;

9–12 months: 100 kcal/kg.

### Conclusion and Recommendations

The excellence of breast milk composition lies in its rich macro- and microelements and biologically active substances, all influenced by several maternal lifestyle factors. Healthy maternal nutrition, avoidance of toxic habits, and improvement of environmental conditions enhance breast milk quality and strengthen infant health. Healthcare systems should continuously monitor breast milk composition, provide education on maternal lifestyle, and recommend supplements as needed to improve the health outcomes of both mother and child.

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