MOTHER'S MILK SUBSTITUTES AND INFANT HUMAN HEALTH

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Contents

Summary

A systems analysis of the problem of artificial feeding of a newborns and children during the first months of their life is conducted and the influence of the composition of an artificial feeding mixture on infant health is ascertained. Patterns of infant development at ontogenesis early stages have been served as a basis for classification of mother's milk substitute. Comparative data are given for compositions of women and cow milks thereby allowing formulation of the adaptation rules for production of the mother milk substitutes. Production methods are described to provide the proper level of fractionating. Alimentation-dependent diseases are the result of irregular feeding of infants during the first months of their life. Indices of infant development are given to be depending on vitamin C and iron contents. Factors are formulated to define harmlessness of mother's milk substitutes. Safety indices established by Ministry of Health of Russia for mother's milk substitutes are given too.

1. Introduction

Mother's milk is the very best food for newborns and children during the first months of their life. It is an ideal product containing all necessary nutrients in optimum quantities and proportions for child health. Mother's milk serves as a source of plastic and energy material which ensures intensive metabolism and building up of many organs of the child's body. Breast milk contains the whole number of biologically active compounds

and protective factors (enzymes, immunoglobulins, hormones, active cell forms, etc.) influencing upon the formation of child's immunity.

According to the data of pediatricians for the last five years, an average length of breast-feeding in Russia varies from 3 to 4 months, many children being deprived of receiving mother's milk from the first days of their life. Not more than 25% of the total number of children of the first-year life are breast-fed after third month; the others are on combined or artificial feeding.

The causes of deficiency or lack of lactation are complex and connected with changes in the mode of life of the society, including women's engagement in earnings, changes of ecological conditions, stress, etc. Irregular malnutrition of a woman during pregnancy and breast-feeding is of no small importance irrespective of the economical level of progress of the human society. Decreasing lactation ability of women is a degenerative phenomenon of civilization.

In the case of deficiency or lack of mother's milk a child lives on combined or artificial feeding with the use of mother's milk substitutes. The main principle of their formulation is an adaptation of the composition, physical and biochemical properties which takes into consideration individual needs of infants in the first year of their life. Otherwise, the probability of occurrence of heavy, irreversible at times, disorders in a child's organism increases, resulting in underdevelopment or dangerous diseases whose consequences can adversely affect the future life of humans.

2. Classification of Mother's Milk Substitutes

There is a sufficiently good assortment of modern mother's milk substitutes. Products for substituting mother's milk are put out as ready-to-eat ones or as dry formulae requiring to be reconstituted; there are non-cultured or cultured milk products for infants. It's recommended that their composition be not only approximated to the composition of mother's milk but also taken into account the age of infants, stage of developing their digestion system, the state of their health.

The development of a child in conformity with the laws of nature in the earlier stages of ontogenesis and changes of its requirements for nutrients and energy connected with it served as a basis for creating three variants of adapted milk formulae, which agrees with the dynamics of mother's milk composition in the different stages of lactation:

- For newborns (from 0 up to 30 days);
- For infants at the age from one up to three months;
- For infants at the age from four months to one year.

A mother's milk substitute for newborns must be fortified with protective factors (lysozyme, bifidobacteria, immunoglobulins, etc.), as mother's milk in the initial stage of lactation contains a considerable amount of these substances which determine the formation of immune status of children. Classification of mother's milk substitutes is shown in Figure.1.

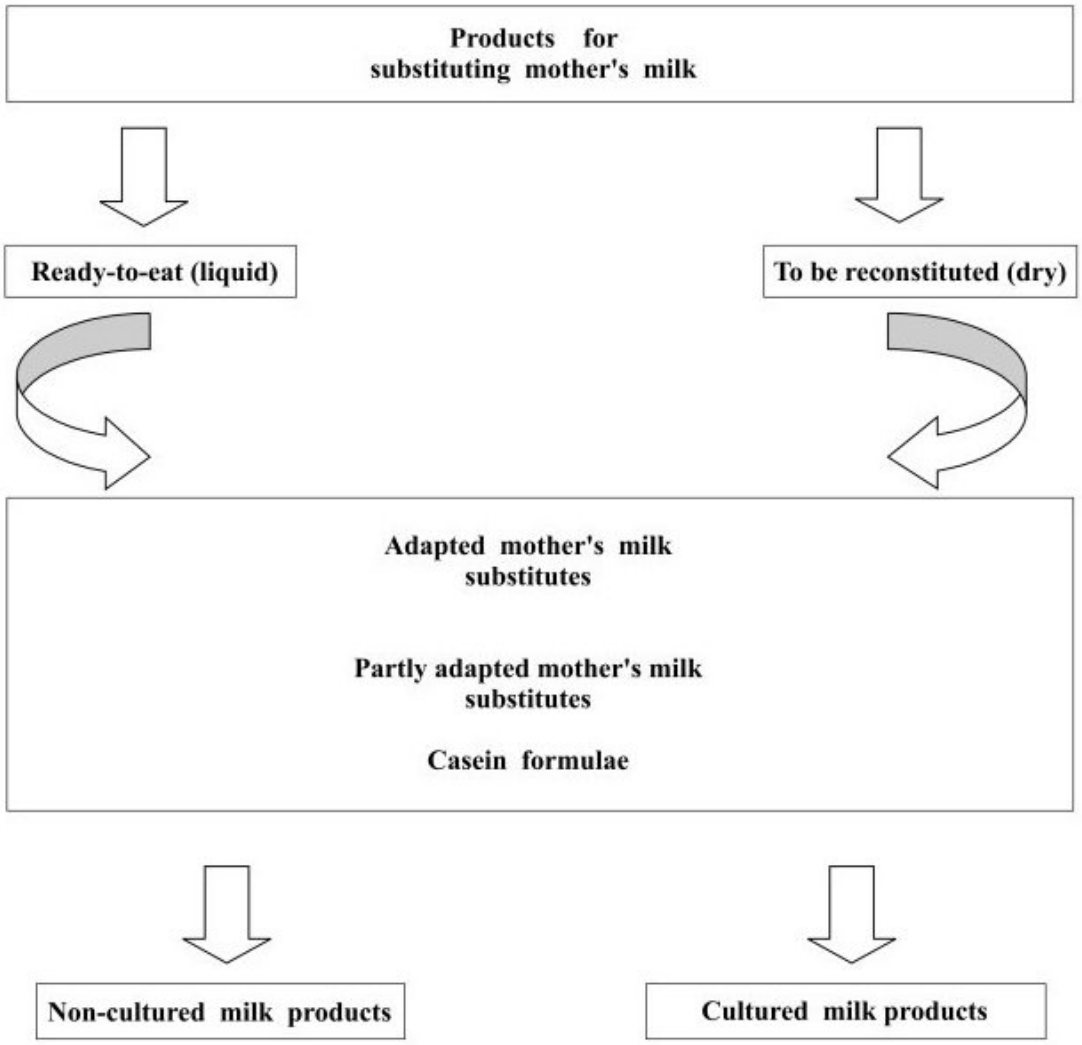

Figure 1: Classification of mother's milk substitutes

3. Mother's Milk as a Criterion for the Development of its Substitutes

Features (Properties) of mother's milk are unique, and it is practically impossible to substitute it. Human milk contains immunoglobulins, which play the role of a local protection of mucous membrane of the intestines, which is especially important in the first days of life when a child's organism cannot produce its own immunoglobulins. Mother's milk contains antibodies against pathogenic strains of intestinal microflora. Obviously, it explains the fact that children breast-fed are very seldom ill with viral diseases. Human milk contains lysozyme – bifidogenic and protective factor. Its concentration in human milk is 300 times as much as in cow milk. With mother's milk hormones enter into a child's organism protecting it from loads on still immature endocrine system. In human milk were detected a hormone of thyroid gland (thyreotropin) and a stimulator of hemopoiesis - erythropoietin. It is extremely difficult to reproduce mother's milk from both technological and economic points of view if to take into consideration its complex component and fractional compositions, the

presence of a great number of immune and bifidogenic factors.

For the manufacture of mother's milk substitutes components of cow milk are used. There is a great difference between mother's milk and cow milk. Data on the content of principal components in mature human milk and cow milk are given in Table 1.

Component	Human milk	Cow milk
Proteins, g	0.9-1.3	2.8-3.2
Whey proteins, %	65-80	20
Casein, %	53-20	80
Lactalbumin, mg	26.0	9.0
Lactoglobulins, mg	-	30.00
Fats, g/100 g	3.9-4.5	3.2-3.5
Linoleic acid, g/100 g of fat	10.8	1.6
PUFA/UFA	0.40	0.04
Carbohydrates, g	6.8-7.2	4.8
Calcium, mg	34.0	120.0
Phosphor, mg	16.0	95.0
Calcium/phosphor	2.1-2.4	1.2-1.3
Sodium, mg	17.0	77.0
Potassium, mg	50.0	143.0
Iron, mg	0.05	0.04
Zinc, mg	0.12	0.4
Iodine, μg	6.0	12.0
Selenium, μg	1.5-2.0	4.0
Vitamins:		
A, mg	0.06	0.03
E, mg	0.24	0.06
C, mg	5.20	1.10
B_1, μg	14.0	43.0
B_2, μg	37.0	156.0

Table 1. Comparative data on composition of human and cow milks (content per 100 ml)

Total protein content of cow milk is 2.4-2.8 times as much as of mother's milk; in addition, the quantities of calcium, phosphor, potassium, sodium, zinc, vitamin B complex in cow milk considerably exceed their quantities in mother's milk. On the contrary, the relative level of linoleic acid, carbohydrates, vitamins A, E, C is lower. This difference concerns not only the quantitative composition of principal components but also the qualitative one. The ratio of whey proteins to casein in mother's milk averages 70:30, whereas in cow milk it is nearly reversed – 20:80. Mother's milk is richer than cow milk in amino acids such as cystine, arginine, isoleucine, tyrosine, that are important for a child's organism . Breast milk contains unique substances, such as taurine and polyamines which are necessary for a growing organism. Taurine is a sulfur-containing amino acid which actively influences the formation of the central nervous

system; it is also necessary for the formation of retina, etc. This amino acid is essential for infants during the first weeks and months of life.

The key features of fat in human milk are the following: high dispersion degree, predominant content of unsaturated fatty acids (UFA). The greatest part of fat in breast milk is represented by triglycerides (98%). Polyunsaturated fatty acids (PUFA) (linoleic, linolenic, arachidonic) in human milk average 9-12% of total lipid composition, whereas in cow milk only 1.3-3.0%. Carnitine enters into the composition of human milk; it is a vitamin-like compound which promotes intracellular transportation and oxidation of fatty acids in infant's organism.

Carbohydrates of human milk are represented mostly by lactose (up to 90%). Its mass content in human milk is 6.5-7.0%, in cow milk 4.7-5.0%. Lactose is present in human milk in β-isomeric form, whereas in cow milk in α-isomeric form. β-lactose promotes the growth of bifidobacteria that inhibit the growth of pathogenic microflora in the intestines. Lactose assimilation takes place in small intestines where it is hydrolyzed producing glucose and galactose. In large intestines lactose is fermented under the influence of B.bifidum producing lactic acid, which results in lowering pH and inhibiting pathogenic microflora.

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Biographical Sketches

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