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Rabbit milk as a source of nutrition for newborns

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Abstract. Based on the charter of the World Health Organization, "health is not only the absence of diseases and physical defects, but also the well-being of a complete physical, mental and social condition." One of the main health problems is that the current state of children's health is characterized by high child mortality under the age of five, especially in the first month of life, which accounts for 50.0% of cases. The fundamental nature of human health is laid back in the perinatal period, which determines the further formation of the body. At the children birth, during unscheduled periods, mothers express milk, which is significantly different in chemical composition from milk obtained from mothers who gave birth at the appropriate time. They have an insufficient amount of nutrients that ensure the normal development and protection of the child's body. In connection with this problem, it was found that rabbit milk, having its stimulating effect, promotes rapid growth, as well as the normal development of the body. The comparative characteristics of the main physicochemical parameters of rabbit milk with cow, goat, and female milk were studied and presented. The amino acid, mineral, fatty acid composition was studied, the biological value was calculated, the lysozyme activity was determined. The qualitative and quantitative composition of amino acids, minerals, as well as high physico-chemical parameters indicates the advisability of introducing rabbit milk into the diet of newborns, especially premature babies.

1. Introduction

The problem of children's and newborns' health is the most urgent today in Russia. The main demographic indicator that characterizes the health status of children is the child mortality rate. Among the main causes of infant deaths are congenital malformations of newborns and pathology of the perinatal period.

Nutrition is an important condition for maintaining health and harmonious formation of the child's body, both in the early and subsequent stages of life. Rational nutrition contributes to the normal physical and neuropsychic development of children, improves working capacity, and increases resistance to adverse interaction with the environment of various infectious and other diseases. The nutrition factor becomes important during periods of infant diseases, which is determined by age-



related physiological and biochemical features, immaturity of a number of organs and systems, significant needs for nutrients and energy, as well as their limited reserves and rapid depletion [1,2,3].

The President of the Russian Federation and regional governors are particularly concerned about this problem. In this regard, perinatal centers are being built, which are well equipped and work in accordance with the set tasks. Meanwhile more than 33 thousand children were born only in the Voronezh region, more than 3700 of which are premature, and about 400 with a body weight less than 1000 g. The expansion of qualified medical care and the construction of new perinatal centers are helping in reducing this indicator.

According to Rosstat data, infant mortality rates in Russia decreased to 6.0 per 1,000 births in 2017, and to 5.1 cases per 1,000 births in 2018. However, the situation remains acute, requiring the development of effective measures to improve the situation. Nutrition plays a critical role in formation of health. For newborns, the first main source of nutrition is the women's milk, but however, the birth of children in unplanned periods leads to changes in the properties of milk, which creates negative conditions for nursing children and providing food of the required quality. The promising way to solve the problem is to find new raw materials as an alternative to women's milk. In this regard, the milk of rabbits is of particular interest, due to which rabbits increase their body weight 40 times in 4 weeks, and also stimulates the development of the body.

The milk productivity of rabbits increases until 19-21 day, and then decreases. It was found that a rapid rise and a rapid fall of milk production after the 21st day, provides better development of young animals, facilitates the transition to vegetable feed before and after weaning. Breeding rabbits for this feature of the lactation curve would allow for an earlier weaning. Early weaning is usually not accompanied by inflammation of the breast, but some rabbits can have mastitis. The disease occurs if the milk is not sucked out in the right amount after kindling. Therefore, timely milking of rabbits is necessary to prevent the development of various diseases [4].

The aim of the work is to compare rabbit milk as a source of basic nutrients in relation to the technology of products, and to assess the possibility of using it in the diet of premature babies.

2. Research materials and methods

The objects of the study were milk obtained in the conditions of LLC "Voronezh rabbit" (Russia, Voronezh, Gazovaya street, 1 A, office 1) from healthy rabbit (Soviet chinchilla breed), white and gray giant at the age of 1-2 years during lactation on day 10, as well as milk from five mothers at the gestation stage of 30-33 weeks in the perinatal center of VOKB No. 1 (Russia, Voronezh, Moskovsky Prospekt, 151). Before taking milk samples from rabbits, nipples were washed with soap, and then the nipples and the pericarp area were treated with a cotton swab moistened with 70% alcohol. Milk collection from rabbits was carried out manually using a sterile syringe, in which milk was decanted by pressing on the mammary gland of the rabbit. Samples of women's (breast) milk were taken at the hospital in compliance with sanitary and hygienic requirements in a specially designated room. Pumping milk is carried out manually or using a breast pumps. Before pumping milk, hands and breasts were washed thoroughly with soap. Then made smooth movements from the base of the breast towards the areola, which stimulates the outflow of milk. The first 5-10 ml of milk was decanted into a separate container, due to the fact that this portion of milk is not suitable for research. The next 4-5 ml was decanted into a sterile container. After decanting, the lid was tightly closed. Voluntary consent from mothers was obtained for the collection and use of milk, and an experiment Protocol was drawn up for the animals, which was approved by the local ethics Committee. Analyzed indicators are determined on the basis of known modern research methods, including certified laboratories [5,6].

The evaluation of organoleptic properties (smell, taste, appearance, and taste) was carried out in accordance with BS ISO 22935-2: 2009 Milk and milk products. Sensory analysis Recommended methods for sensory evaluation.

The Kjeldahl method was used to study the mass fraction of protein, and the method of ion exchange chromatography with post-columnar derivatization with ninhydrin was used to determine amino acids, including tryptophan chromatography with post-columnar derivatization. Protein

determination was performed using the Turbotherm protein decomposition unit (Gerhardt, Germany) and the Vapodest ammonia distillation unit (Gerhardt, Germany). The analysis of the amino acid composition and tryptophan was performed on the LC-20 Prominence liquid chromatograph (Shimadzu, Japan).

Also, the carbohydrate composition of rabbit milk was analyzed using a chromatograph with chromeleon SOFTWARE (Germering, Germany) using high-performance anion-exchange chromatography with pulsed amperometric determination. This method is a more sensitive, accurate and widely used method for determining monosaccharides, disaccharides, oligosaccharides, and polysaccharides.

The mineral composition of the studied objects was determined using x-ray waves on the S8 Tiger wave x-ray fluorescence spectrometer (Bruker, Germany). The study of the prepared samples for fatty acid composition was carried out on the Agilent 7890B GC System chromatograph with the Agilent 5977A MSD mass detector (Agilent Technologies, SCA).

The activity of lysozyme was studied by seeding on nutrient media of MPA and Mrs with *Streptococcus* culture. The method used makes it possible to determine the activity of the lysozyme by measuring the diameter of the lysis zone around the hole in the agar in which the sample was introduced.

3. Research result

The organoleptic characteristics of rabbit milk are white color with a cream tint, creamy consistency (similar to the cream of cow's milk), odorless with a salty taste. Breast milk is a white opaque liquid with a characteristic smell and sweet taste. The consistency of both samples is a homogeneous liquid without sediment and flakes (figure 1).



Figure 1. Milk samples: (a) – rabbit milk; (b) – breast milk

Figure 2 shows the physical and chemical parameters of the compared types of milk. Data on indicators of cow and goat milk are taken in the research Karimova, G. D. et al. (2014) [7]. According to the data obtained, the rabbit milk in the amount of protein significantly exceeded other compared types of milk, making up 12.6%. The mass fraction of fat was also increased to 10% [8,9].

Figure 3 shows a chromatogram of the carbohydrate composition of rabbit milk. The content of lactose in rabbit milk was 0.899%, which is significantly inferior to the studied types of milk, and the content of galactose -0.007%, glucose-0.01% was also established.

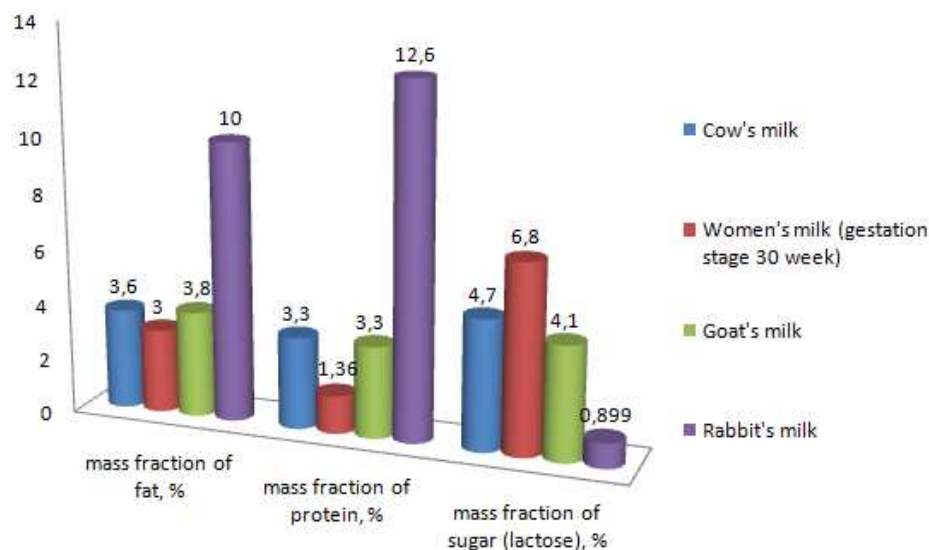


Figure 2. Comparative physical and chemical composition

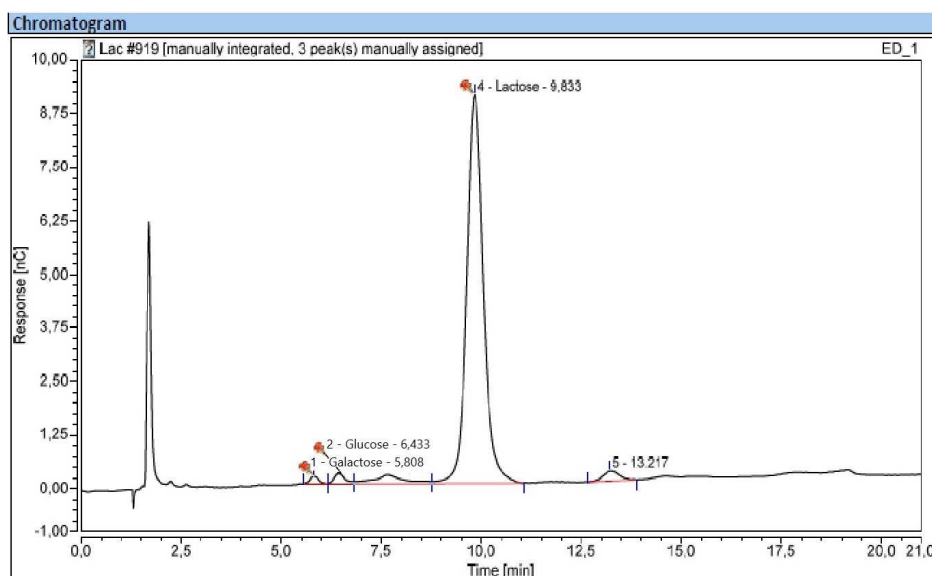


Figure 3. Carbohydrate composition of rabbit milk: 1-galactose, 2-glucose, 4-lactose

Table 1 shows the amino acid composition of different milk samples. According to the research results, it was found that the estimated biological value of rabbit milk (according to Acad. Lipatov N. N.) was between cow's and goat's milk, making up 67.4%, but also higher by 2.5 times in a sample of female milk (gestation stage 30 week).

The minerals are important components that ensure normal functioning and maintenance of physiological functions in the body. The comparative mineral composition of rabbit and breast milk is shown in table 2. In the course of experimental studies, it was shown that rabbit milk is superior to women's milk in terms of basic minerals. Of great importance for the formation of human bone tissues, especially in childhood, are calcium salts, the content of which in rabbit milk was 1.08% by weight, which is significantly (9 times more) than in women's milk (gestation stage 30 week). There was also

an increased content of elements such as potassium, sodium, and phosphorus, which create and maintain osmotic pressure and buffer systems in the blood [10].

Table 1. Amino acid composition

Name of amino acid	FAO/ who Scale, g / 100g of protein	Content of essential amino acids (g / 100g of protein)			
		cow's milk	goat's milk	women's milk (gestation stage 30 week)	rabbit's milk
Valin	5.0	6.4	6.48	4.27	5.46
Isoleucine	4.0	4.7	4.18	3.88	4.25
Leucine	7.0	9.5	8.45	7.65	9.01
Lysine	5.5	7.8	7.29	5.48	6.34
Methionine	3.5	3.3	3.0	0.05	2.6
Threonine	4.0	4.4	4.88	3.73	4.48
Tryptophan	1.0	1.4	1.22	0.64	0.65
Phenylalanine	6.0	8.2	8.7	3.22	4.3
Arginine	5.8	3.5	2.67	26.72	15.16
Amino acid score (%)					
Isoleucine		117.5	104	97	106
Leucine		136	120	109	128
Lysine		142	132	100	115
Methionine		94	85	1.4	74
Threonine		110	122	93	112
Tryptophan		140	122	64	65
Phenylalanine		170	145	54	72
Valin		128	129	85	109
KRAS,%		31.2	34.8	74.03	32.6
BC,%		68.8	65.2	25.9	67.4

Table 2. Mineral composition

Minerals	Rabbit milk, (wt%)	Women's milk (gestation stage 30 week) (wt%)
Sodium	0.25±0.05	0.15±0.05
Magnesium	0.075±0.05	0.017±0.05
Aluminum	0.011±0.03	0.011±0.03
Silicon	0.025±0.01	0.023±0.01
Phosphorus	0.69±0.2	0.063±0.2
Sulfur	0.35±0.06	0.078±0.06
Chlorine	0.37±0.03	0.25±0.03
Potassium	0.47±0.04	0.26±0.04
Calcium	1.08±0.1	0.11±0.1

A balanced fatty acid composition of the nutrition of infants and post-adolescent children is extremely important in solving the problem of early warning of atherosclerosis, hypertension and obesity. Table 3 shows the results of studies of fatty acid composition. According to the content of fatty acids, rabbit milk is much closer to breast milk. It is worth noting the predominance of fatty acids such as linoleic and myristic, which have an anti-inflammatory effect, helping to restore the protective properties of the skin and strengthen cell membranes. Also, stearic and lauric fatty acids that exhibit antimicrobial and antibacterial effects that have a negative effect on pathogenic microorganisms, bacteria, etc. [11].

Table 3. Fatty Acid composition

Fatty acids	Rabbit milk (%)	Women's milk (gestation stage 30 week) (%)
Caproic (C6:0)	0.25±0.4	-
Caprylic (C8:0)	13.82±2.2	0.15±0.4
Capric (C10:0)	-	1.29±0.4
Lauric (C12:0)	3.23±0.4	5.11±2.2
Myristic (C14:0)	3.32±0.4	5.86±2.2
Palmitic (C16:0)	22.64±2.2	24±2.2
Palmitoleic (C16:1)	1.64±0.4	3.86±0.4
Stearic (C18:0)	3.55±0.4	6.33±2.2
Oleic (C18:1)	15.33±2.2	31.85±2.2
Linoleic (C18:2)	18.52±2.2	16.6±2.2
Linolenic (C18:3)	1.49±0.4	0.32±0.4
Arachic (C20:0)	0.08±0.4	0.13±0.4
Gondoin (C20:1)	0.2±0.4	0.41±0.4
Eicosadifhenic (C20:2)	0.16±0.4	0.48±0.4
Behenic (C22:0)	0.03±0.4	0.09±0.4

Figure 4 shows the results of a preliminary study of lysozyme activity. When comparing female (breast) milk at the gestation stage of 30 weeks and rabbit milk, it was found that in the latter case, the lysis zone increased by 1.5 times. This indicates that rabbit milk has more immunological and bactericidal effects.

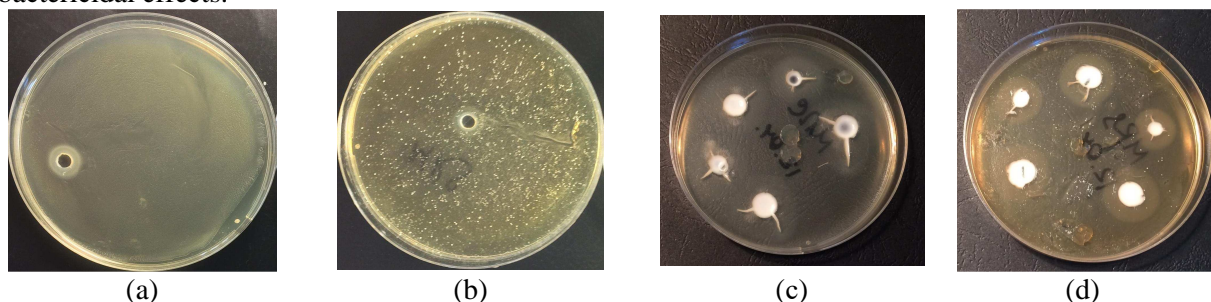


Figure 4. Determination of lysozyme activity on the nutrient medium of MPA and MRC with Streptococcus culture: (a) and (b) - in female (breast) milk (gestation stage 30 week); (c) and (d) - in rabbit milk

4. Discussion of results

After conducting research, it was found that the milk of rabbits in terms of protein content is 4 times higher than cow's and goat's milk, and women's milk is 9 times, but is inferior in terms of sugar-lactose by about 5 times.

It was also found that the estimated biological value of rabbit milk for amino acids was 67.4%, but it is particularly noteworthy that the increase in the composition of arginine proteins – an essential amino acid for the child's body, it exceeded cow's and goat's by 4.5 – 5.0 times, but by 1.5 times less than in breast milk. Also, the content of the essential amino acid methionine in women's milk (gestation stage 30 week) was 0.05 g/100g of protein, which is 3 times lower than in other compared types of milk. This circumstance requires further in-depth study of this object, in view of the known powerful effect of rabbit milk on body weight gain.

The increased content of mineral substances, as well as the optimal content of fatty acids in rabbit milk, which contributes to the normal development and growth of the human body, was revealed.

Also, an increase in the activity of rabbit milk lysozyme in comparison with female (gestation stage 30 week) suggests that it is more protected from the effects of harmful environmental factors.

5. Conclusion

The studies have shown that the milk of the rabbit corresponds to the balanced formula food for all nutrients, proper application of which ensures intake of sufficient nutrients appropriate qualitative composition of which corresponds to the adaptive capacity of the organism, the enzymatic function of the gastrointestinal tract and the state of metabolic processes. Thus, the results obtained prove the prospects of using rabbit milk in the composition of milk mixtures.

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