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Efficiency of Using the Adapted Goat's Milk Formula in the Diet of Healthy Young Infants: a Multicenter Prospective Comparative Study

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Background. *There is no doubt that it is necessary to study the efficiency of milk formulas that are introduced into the Russian market of baby food. This applies to both new products and known brands of formulas whose composition is subject to change.* ***Objective:*** *Our aim was to assess the clinical efficacy of the adapted goat's milk formula in the diet of young infants.* ***Methods.*** *We conducted a prospective comparative study with healthy full-term children aged 0-5 months being on a formula (main group) or breast feeding (comparison group). The tolerability of the adapted goat's milk formula, the dynamics of anthropometric indicators, changes in body composition as well as microscopic characteristics of stool and general clinical and biochemical parameters of peripheral blood were assessed after 1 month.* ***Results.*** *Good tolerability of the goat's milk formula was noted in 184 (96.8%) of 190 children in the main group. In the course of taking the product, the proportion of children with functional disorders of the gastrointestinal tract decreased significantly from 57 (30%) to 27 (14%) ($p < 0.001$). Physical development, complete blood count results, the levels of ferritin, prealbumin and 25(OH)D in children of the main group and the comparison group ($n = 71$) were comparable and were within the mean age parameters. Qualitative analysis of the level of specific IgE to goat's milk proteins did not reveal any sensibilization in any of the children receiving the milk formula, either at the beginning of the study or after 1 month of taking the product.* ***Conclusion.*** *The studied adapted goat's milk formula can be used in nutrition of young infants in cases of lack or absence of mother's milk.*
Key words: *healthy children, early infancy, human milk, cow's milk, goat's milk, milk formula, tolerability.*

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RESULTS

Table 1. Clinical characteristics of children in the compared groups

Indicator	Main group (n = 190)	Comparison group (n = 71)	*p*
Age, months	3.4 ± 1.7	2.8 ± 1.4	0.273
Girls, abs. (%)	105 (55)	42 (59)	0.568
Rickets I degree, abs. (%)	38 (20)	12 (17)	0.856
Functional disorders of the GIT, abs. (%)	57 (30)	18 (25)	0.753
• Liability to constipation	39 (20)	14 (20)	1.000
• Unstable stool	12 (6)	3 (4)	0.748
• Posseting	41(22)	15 (21)	1.000
• Bloat	20 (11)	8 (11)	1.000
• Colic	41 (22)	17 (24)	0.868
Burdened allergic anamnesis, abs. (%)	22 (12)	6 (9)	0.686

Note. GIT **—** gastrointestinal tract.

Table 2. Distribution dynamics of Z-values of the ratio of body mass index to age in children in the compared groups

Period	Groups	Z-values				
		< -2	-2 − < -1	-1 − +1	> +1 − < +2	> +2
Initially, abs. (%)	Main (n = 190)	6 (3.1)	10 (5.3)	163 (85.8)	7 (3.7)	4 (2.1)
	Comparison (n = 71)	3 (4.2)	3 (4.2)	54 (76.1)	7 (9.9)	4 (5.6)
After 1 month, abs. (%)	Main (n = 185)	3 (1.1)	5 (2.6)	175 (92.1)	6 (3.1)	2 (1.1)
	Comparison (n = 71)	2 (2.8)	3 (4.2)	61 (86.0)	4 (5.6)	1 (1.4)

Table 3. Distribution dynamics of Z-values of the ratio of body weight to body length in children in the compared groups

Period	Groups	Z-values				
		< -2	-2 − < -1	-1 − +1	> +1 − < +2	> +2
Initially, abs. (%)	Main (n = 190)	5 (2.6)	8 (4.2)	165 (86.9)	8 (4.2)	4 (2.1)
	Comparison (n = 71)	2 (2.8)	6 (8.5)	55 (77.4)	6 (8.5)	2 (2.8)
After 1 month, abs. (%)	Main (n = 185)	2 (1.1)	6 (3.1)	175 (92.1)	5 (2.6)	2 (1.1)
	Comparison (n = 71)	1 (1.4)	3 (4.2)	64 (90.2)	1 (1.4)	2 (2.8)

Table 4. Distribution of Z-values of the ratio of body weight to age

Period	Groups	Z-values				
		< -2	-2 − < -1	-1 − +1	> +1 − < +2	> +2
Initially, abs. (%)	Main (n = 190)	5 (2.6)	10 (5.3)	160 (84.2)	9 (4.7)	6 (3.2)
	Comparison (n = 71)	3 (4.2)	6 (8.5)	52 (73.2)	5 (7.1)	5 (7.1)
After 1 month, abs. (%)	Main (n = 185)	4 (2.1)	8 (4.2)	166 (87.4)	8 (4.2)	4 (2.1)
	Comparison (n = 71)	1 (1.4)	6 (8.5)	58 (81.7)	4 (5.6)	2 (2.8)

Table 5. Distribution of Z-values of the ratio of body length to age

Period	Groups	Z-values				
		< -2	-2 – < -1	-1 – +1	> +1 – < +2	> +2
Initially, abs. (%)	Main (n = 190)	2 (1.1)	8 (4.2)	169 (88.9)	9 (4.7)	2 (1.1)
	Comparison (n = 71)	1 (1.4)	5 (7.0)	53 (74.7)	8 (11.3)	4 (5.6)
After 1 month, abs. (%)	Main (n = 185)	1 (0.5)	7 (3.7)	171 (90.0)	9 (4.7)	2 (1.1)
	Comparison (n = 71)	1 (1.4)	5 (7.0)	55 (77.5)	8 (11.3)	2 (2.8)

Table 6. Dynamics of coprological examination indicators in children who received a goat's milk formula (n = 42)

Indicator	Initially, abs. (%)	After 1 month, abs. (%)	*p*
Seedy stool	33 (79)	38 (91)	0.063
Mucus	12 (29)	6 (14)	0.031
Neutral fat	8 (19)	4 (10)	0.125
White blood cells	5 (12)	4 (10)	1.000
Response to latent blood	0	0	-

Table 7. Dynamics of peripheral blood values in the examined children

Value	Norm*	Initially		*p*	After 1 month		*p*
		Main group (n = 190)	Comparison group (n = 71)		Main group (n = 185)	Comparison group (n = 71)	
Hemoglobin, g/L	110–135	115 ± 7	112 ± 10	0.779	118 ± 98	116 ± 11	0.665
Erythrocytes, 10^{12}/L	3.1–4.6	4.3 ± 0.7	4.1 ± 0.5	0.229	4.5 ± 0.7	3.9 ± 0.4	0.010
MCH, pg	25–35	27.9 ± 1.8	29.3 ± 1.2	0.412	29.4 ± 1.4	30.3 ± 1.9	0.001
Eosinophils, %	1–5	3.8 ± 1.3	4.1 ± 2.2	0.658	4.1 ± 1.8	5.1 ± 2.6	0.111
Reticulocytes, ‰	3.5–13.4	9.2 ± 6.2	12.7 ± 3.2	0.629	9.8 ± 5.6	12.5 ± 4.2	0.194
RET-He, pg	28.4–35.6	30.5 ± 2.3	28.4 ± 2.5	0.392	29.8 ± 1.8	30.4 ± 1.3	0.001

Note. * **—** Reference intervals used in the laboratory. MCH - mean cell hemoglobin, RET-He - reticulocyte hemoglobin content.

Table 8. Dynamics of biochemical values in the examined children

Value	Norm *	Initially		*p*	After 1 month		*p*
		Main group (n = 42)	Comparison group (n = 31)		Main group (n = 42)	Comparison group (n = 31)	
Ferritin, ng/ml	10–340	150 ± 103	94 ± 77	0.006	211 ± 101	208 ± 162	0.001
Prealbumin, mg/L	180–380	152 ± 28	164 ± 24	0.061	148 ± 28	151 ± 24	0.844
25(OH)D, ng/ml	20–70	46 ± 31	49 ± 27	0.604	27 ± 19	28 ± 14	0.001

Note. * **—** Reference intervals used in the laboratory.

Table 9. Chemical composition and energy value of cow's and goat's milk [2] in comparison with human milk [1]

Ingredients	Milk (in 100 ml)		
	Goat	Cow	Human
Proteins, g	2.9–3.1	2.8–3.2	0.9–1.3
• Casein, %	75	80	19–26
• Whey proteins, %	25	20	81–74
Fats, g	4.2	3.2	3.9–4.5
• PUFA ratio ω6/ω3	3/1	3/1	10/1–7/1
Carbohydrates (lactose), g	4.5	4.8	6.8–7.2

Energy value, kcal	68	58	70
Mineral substances, g	0.8	0.7	0.2
• Calcium, mg	143	120	25.5
• Phosphorus, mg	89	90	13
• Ca/P ratio	1.6	1.3	2.0
• Ferrum, μg	100	67	40
Vitamins:			
• C, mg	2.0	1.5	6.2
• B_1 mg	0.04	0.04	0.02
• B_2 mg	0.14	0.15	0.06
• B_6 mg	0.05	0.05	0.02
• B_{12} μg	0.1	0.4	0.07
• PP, mg	0.3	0.1	0.23
• Folic acid, μg	1.0	5.0	5.5
• A, mg	0.06	0.03	0.06
• D, μg	0.06	0.05	0.12
• E mg	0.09	0.09	0.43

Note. PUFA - polyunsaturated fatty acids.

Table 10. Comparative fractional composition of goat's [4], cow's [4] and human milk [1]

Protein Fractions	**Milk (in 100 ml)**		
	Goat	**Cow**	**Breast**
αs1-casein	0-0.97	1.37	-
β-casein	2.28	0.62	0.25
γ-casein	-	0.12	-
β-lactoglobulin	0.26	0.3	-
α-lactalbumin	0.43	0.07	0.3
Immunoglobulin A	-	0.06	0.1
Lysozyme	Trace levels	Trace levels	0.05
Lactoferrin	Trace levels	Trace levels	0.17
Whey albumin	-	0.03	0.06

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CONFLICT OF INTERESTS

Tatyana E. Borovik, Natalya N. Semyonova, Olga L. Lukoyanova, Natalya G. Zvonkova, Tatyana V. Bushueva, Tatyana N. Stepanova, Vera A. Skvortsova, Oleg S. Melnichuk, Elena A. Kopyltsova, Elena L. Semikina, Irina N. Zakharova, Irina I. Rjumina, Marina V. Narogan, Elena V. Grosheva, Roman A. Chanpherjan, Elena A. Savchenko, Tamara V. Belousova, Tamara. N. Elkina, Ekaterina A. Surovkina, Yulia A. Tatarenko — conducting scientific study with the support of Hyproca Nutrishion East Limited.

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