ANALYSIS OF CHEMICAL PARAMETERS FOR THREE TYPES OF RECONSTITUTED MILK POWDER

ANALIZA UNOR PARAMETRI CHIMICI PENTRU TREI TIPURI DE LAPTE PRAF RECONSTITUIT

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Abstract. *The infant formula means a breast milk substitute specifically made to meet the nutritional requirements of infants during the first few months of life until appropriate complementary feed is introduced. Milk intake in the baby's diet is recommended for at least the first two years of life, maternal - at least six months, the animal or the formula of reconstituted milk powder - further, due to the essential nutritional principles in growth and physical and cognitive development. The chemical parameters analyzed in the present paper follow the quality of three milk powders (infant formula, next step formula and lactose-free formula) and three types of water (marketed, tapped and filtered) used for reconstitution with regard to acidity and content in nitrite, chloride, sulphite and phosphate ions.*

Key words: milk powder, nitrite, chloride, sulphite, phosphate

Rezumat. *Formula pentru sugari înseamnă un înlocuitor de lapte matern fabricat special pentru a satisface, prin el însuşi, cerinţele nutriţionale ale sugarilor în primele luni de viaţă până la introducerea hranei complementare adecvate. Aportul de lapte în alimentaţia copilului este recomandat cel puţin în primii doi ani de viaţă, matern – minim şase luni, animal sau formula de lapte praf reconstituit – în continuare, datorită principiilor nutritive esenţiale în creşterea ;i dezvoltarea fizică şi cognitivă.*

Parametrii chimici analizaţi în prezenta lucrare urmăresc calitatea a trei formule de lapte praf (de început, de continuare şi delactozat) şi a trei tipuri de apă (comercializată, de robinet şi filtrată) folosite pentru reconstituire, în privinţa acidităţii şi a conţinutului în ioni azotit, clor, sulfit şi fosfat.

Cuvinte cheie: lapte praf, azotit, clor, sulfit, fosfat

INTRODUCTION

Some categories of infant and young children baby-food, especially powdered milk formulas with different peculiarities, are frequently recommended by pediatricians, by age group and according to the nutritional needs of each case.

"Infant formulas" means those foods which are intended for the particular nutritional use of infants during the first 4 to 6 months of life and which may satisfy themselves the nutritional requirements of this category of persons.

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"Follow-on formulas" means foods for particular nutritional uses in children over 4 months of age and which constitute the main liquid component of the progressively diversified diet of this category of persons (Usturoi, 2008)

Ingredients as well as new techniques in the dairy industry minimize the difference between formulas and maternal milk through molecular biology, allowing for the widespread production of recombinant proteins in human milk and bioactive substances with proven effects on nutrient use and other health benefits.

When developing a new or modified formula for infants, the goal is to reproduce the benefits of breast milk (Vivatvakin, 2010).

The water used for the preparation of milk formulas is very important and therefore requires increased attention. On the milk cans there are instructions indicating the optimal temperature of the water used to prepare the formula, but the water source is not specified, only that it must be safe to consume. But it is recommended to use for this purpose microbiologically tested tap water or bottled flat water with a low degree of hardness.

Also, the level of nitrites in water must be below 10 mg/L as a maximum allowed limit for the water used for reconstitute powder milk formulas. Therefore, water from untested wells, especially from rural areas, is inappropriate for use in small children's diet.

Cold storage also influences the physical-chemical parameters of the milk powder, with very significant effects on titratable acidity, humidity and dry matter content. (Semeniuc *et al*, 2012)

This paper aims to analyze changes in physicochemical parameters for three types of formulas (infant, follow-on, lactose free) combined with three types of water (tap, filtered and bottled) during storage at 4-6^{0}C.

MATERIAL AND METHOD

The following samples were analyzed, with the characteristics offered by the producers in case of the formulas:

P 1 – Bottled Baby spring flat water;
P 2 – Filtered tap water;
P 3 – Tap water;
P 4 – Bebelac 1 infant formula 0 – 4 months;
P 5 – Bebelac 2 follow-on formula 6 – 12 months;
P 6 – Topfer lactose free formula.

The following physical and chemical parameters were tested: moisture and dry matter (by oven drying method at 105^{0}C) for the milk formulas, pH (potentiometric method), titratable acidity (volumetric method and expression in mg lactic acid/100 mL), hardness (volumetric complexometry method and expression in German degrees) for the analyzed water types, nitrites content (Griess reagent colorimetric method and Spekol 1100), chloride content (Mohr method with silver nitrate reagent), sulphite content (iodometry titration method) and phosphate content (sulphuric molybdenum reagent colorimetric method and Spekol 1100). In order to determine the considered parameters, especially the ones using colorimetric methods, the reconstituted milk samples were deproteinized and filtered.

The considered samples were numbered according to the original samples, therefore resulted nine reconstituted milk samples (for example P4-1 = Bebelac 1 formula reconstituted with bottled Baby spring flat water).

RESULTS AND DISCUSSIONS

As regards the moisture and dry matter of the analyzed powder milk formulas, the values are shown in table 1.

Table 1

Humidity and dry matter values for the analysed milk formulas

Sample	Humidity (%)	Dry matter (%)
P 4	2.4339	97.5661
P 5	2.0283	97.9716
P 6	1.2469	98.7530

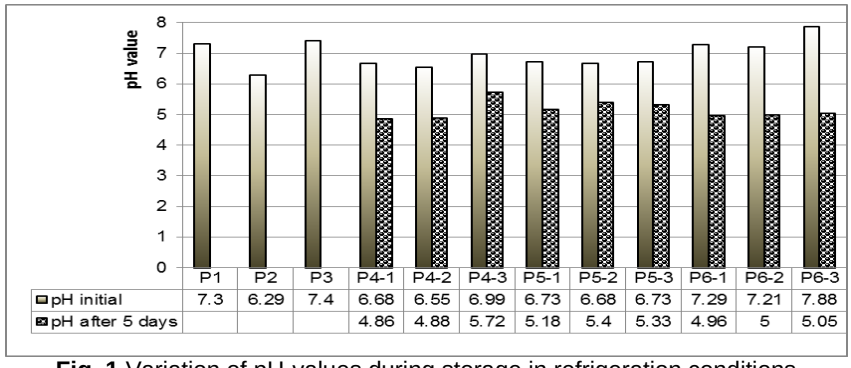
Hardness values for the types of water used in combination with the formulas were tested through complexometry method using a standard 0.001 M solution of Na_2EDTA and eriochrome black T as indicator. The lowest value was registered for P 1, the commercial Baby spring flat water (tab. 2).

Table 2

Hardness value in German degrees for tested water samples

Sample	Humidity (%)
P 1	7.1496
P 2	8.1629
P 3	10.9215

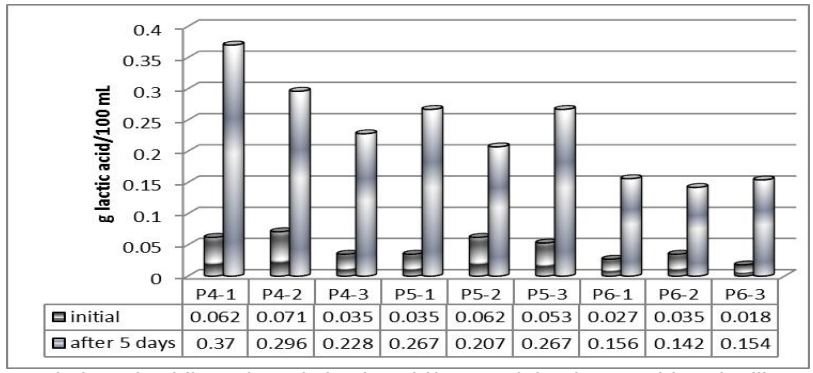
The pH values were determined initially when the formulas were mixed with heated water and again after five days, the samples of reconstituted milk being maintained at 4-6°C. Recorded data are shown in figure 1, observing that the biggest drop in pH value was registered for the P6-3 combination.



	P1	P2	P3	P4-1	P4-2	P4-3	P5-1	P5-2	P5-3	P6-1	P6-2	P6-3
pH initial	7.3	6.29	7.4	6.68	6.55	6.99	6.73	6.68	6.73	7.29	7.21	7.88
pH after 5 days				4.86	4.88	5.72	5.18	5.4	5.33	4.96	5	5.05

Fig. 1 Variation of pH-values during storage in refrigeration conditions

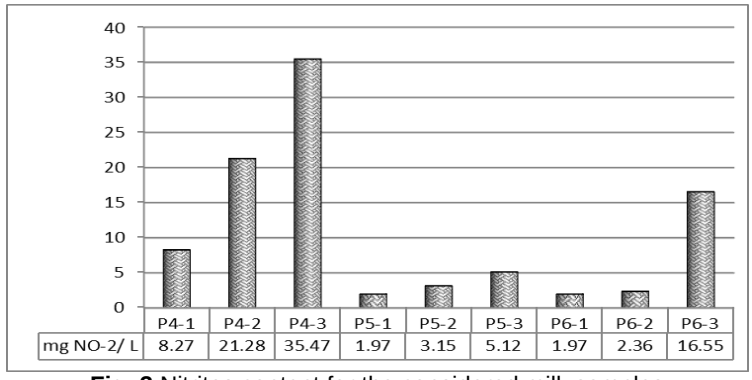
Acidity was expressed in g lactic acid/100 mL and the determinations were also made initially and after five days from the reconstitution of the milk samples. The obtained values are presented in figure 2.



	P4-1	P4-2	P4-3	P5-1	P5-2	P5-3	P6-1	P6-2	P6-3
initial	0.062	0.071	0.035	0.035	0.062	0.053	0.027	0.035	0.018
after 5 days	0.37	0.296	0.228	0.267	0.207	0.267	0.156	0.142	0.154

Fig. 2 Variation of acidity values (g lactic acid/100 mL) for the considered milk samples

The acceptable daily intake established by World Health Organization for nitrates is 0-3,7 mg / kg bodyweight and for nitrites is 0-0,07 mg / kg. It is also stated that these values do not apply to infants under the age of 3 months (EFSA, 2008; Yeh *et. al*, 2013), therefore the nitrite content (adding the reduced nitrates) for the milk samples was determined and presented in figure 3.



	P4-1	P4-2	P4-3	P5-1	P5-2	P5-3	P6-1	P6-2	P6-3
mg NO-2/ L	8.27	21.28	35.47	1.97	3.15	5.12	1.97	2.36	16.55

Fig. 3 Nitrites content for the considered milk samples

From the analysis of the chloride ion in the reconstituted milk types it was found that in general, the sample P4 and P5 (Bebelac 2 and Topfer) recorded higher values for chloride content, combined with all three types of water (fig. 4).

The sulphite content was higher also for the reconstituted P4 and P5 formulas, varying slightly with the water used; the only sample sulphite free was P4-1, the mixture of Bebelac 1 and bottled Baby spring flat water (fig. 5).

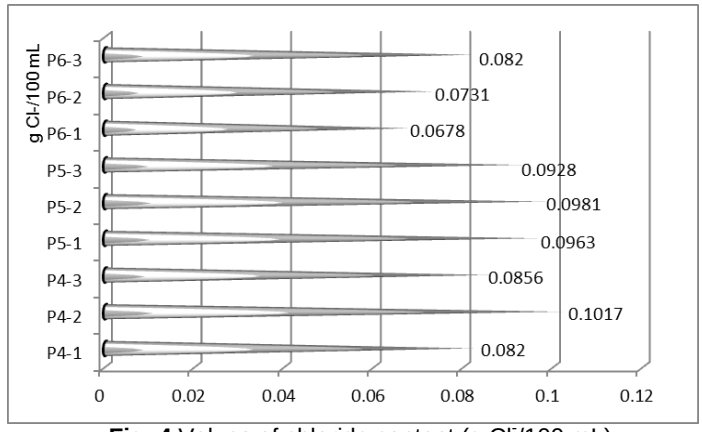


Fig. 4 Values of chloride content (g Cl^-/100 mL)

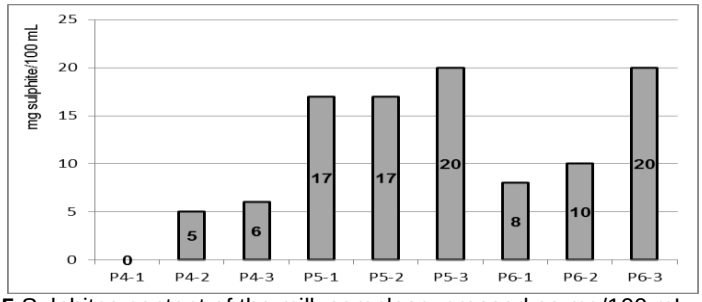


Fig. 5 Sulphites content of the milk samplesexpressed as mg/100 mL

The maximum allowed intake for phosphate ion in food for children 1 to 3 years old is 3000 mg per day; considering that milk is the main source of phosphate for infants, we tested these reconstituted formulas, observing that the highest values were obtained for P6 (Topfer lactose free formula), followed by P4 (Bebelac 1) (fig. 6).

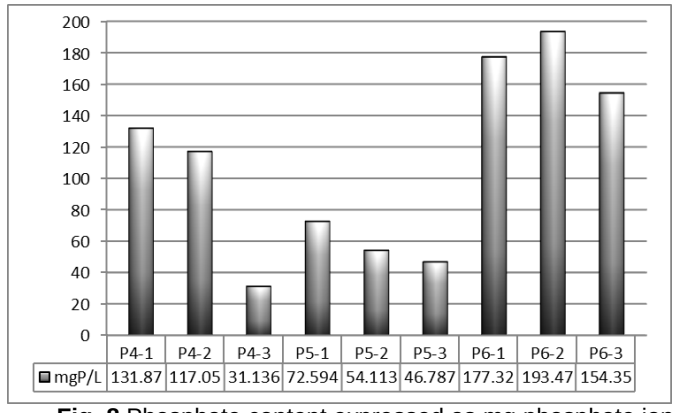


Fig. 8 Phosphate content expressed as mg phosphate ion/L

CONCLUSIONS

1. Dry matter content of the considered three brands of formula varied between 98.75 – 95.56%;

2. Most of the reconstituted milk samples dropped 1 or 2 units of pH in five days during refrigeration, except P6-3, where pH decreased with 2.83 units;

3. Free acids content increased in five days of storage for all the milk samples three times or more; the sample with the biggest difference was P4-1;

4. The chloride content varied from 0.0678 to 0.1017 g Cl^-/100 ml, with small differences between samples;

5. The lowest nitrites content was found for P1 formula, in general, no matter the added water type considered;

6. Sulphite content showed smaller values also for Bebelac 1 infant formula, while Topfer lactose free formula provided the highest intake of phosphate ions.

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