ISSN: 0975 -8542

Journal of Global Pharma Technology

Available Online at: www.jgpt.co.in

RESEARCH ARTICLE

The Extent to Which Some of the Infant Formulas Available in Iraqi Markets Conform to the Standards and Meet the Requirements of Ideal Infant Growth

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Abstract

This study was conducted in the laboratories of the College of Agriculture \ University of Kufa and the laboratories of the College of Food Sciences \ University of Al-Qasim Green. To determine the extent to which the specifications of different samples of infant milk formulas available in the local markets of Najaf province meet the standard specifications, meet the requirements of the ideal growth of Infant, and compare them with the overall composition of breast milk. Four replicates of different production batches were used for each model of infant formula. Nactalia1, Dielac1, Evolac1, Celia2, Dielac2 and Sunnybaby2.The results showed a decrease in the amount of energy processed by the milk formulas Dielac1, Celia2 and Sunny baby2, which were 65.48, 63.27 and 65.78 kcal / 100 ml, respectively, compared to the amount of energy provided by the mother to her infant. The amount of protein in all Infant milk formulas with genetic fructose intolerance especially during the first four months of life. It was also observed that the percentage of whey protein in the milk formulas Dielac1, Evolac1 and Dielac2 was similar to that in cow's milk at 17%, 20% and 16%, respectively. But increased to 25% in Celia2 milk and were close to the proportion of breast milk in the milk formula of Sunnybaby2 and Nactalia1 48% and 52%, respectively. It was also found that both mothers and experts accepted all infant milk formulas under study.

Keywords: *Infant formula, Nitrogen distribution, Sensory evaluation.*

Introduction

Milk is one of the most important components of the human diet in many parts of the world. Milk consumption varies significantly across the world, with per capita consumption of 50 kg per year in China and Japan reaching 180 kg / year in Iceland and Finland. Milk contains all the nutrients necessary to sustain physiological functions in the body as well as containing fat, proteins, enzymes and bio particles active. It is also a good source of calcium, phosphorus and fat-soluble vitamins, so it is one of the most natural foods beneficial to humans at all stages of life.

There is no doubt that breast milk is the ideal food for an infant compared to other types of milk [3]. And mother's milk is adapted to the needs of the baby as it grows and develops [4]. According to the American Academy of Family Physicians (AAFP) [5], breast feeding is the optimal physiological model for both mother and infant. The World Health Organization (WHO) stressed the need to breastfeed the baby, especially during the first six months of life. The decision to use breast or artificial breastfeeding is very personal and is often influenced by many factors [7]. Despite the importance of breastfeeding, the trend towards breastfeeding began to spread widely in all countries for many reasons.

The most important of which is the mother's involvement in the labor market and her absence from home for long hours or because of exposure to some infectious diseases that can be transmitted to her baby. In some cases, the mother is unable to produce and give milk [8]. Breastfeeding is a very common practice in Iraq as most mothers prefer to feed their infants with formula instead of breast milk [9]. Since Iraq depends on imports to meet the needs of infant food and

young children. Markets are open to various food commodities, especially infant formula. It was noticed in a monitoring study carried out by the Center for Market Research and Consumer Protection there are many types of milk formulas imported Infants, which are produced from different companies. It was also observed a lack of some card information Significance [10].

Because of this quantitative and qualitative multiplicity, the process of proper selection has become more difficult. Identifying differences between one structure and another requires careful and focused study. Due to the lack of such studies, this study was conducted to identify the overall composition of some infant formula formulas available in the local markets and their conformity with some standards and meet the requirements of optimal growth for infants and young children.

Materials and Methods

Sampling: A comprehensive survey of the types of milk formulas available in pharmacies and local markets in Najaf Governorate. Six models were selected, including three models of infant formula for the first age (less than 6 months), Nactalia1, Dielac1 and Evolac1, the best-selling and affordable for consumption by poor families, which represent the largest proportion of Iraqi society.

Three models of milk formulas were also selected for the second age group (more than 6 months): Celia2, Dielac2 and Sunny baby2. The information recorded on the identification card was noted from the brand, the country of manufacture, the date of production, the number of the production meal, the expiry date, and the nutrients.

Samples were transported from the markets directly to the laboratory and stored at laboratory temperature until laboratory tests were carried out as stated in [11].

Moisture Determination (%)

The moisture content of the milk samples was estimated to be dried in the drying oven at 102 ° C ± 2 ° C for 2 hours or until the weight was stable according to the method described by [12].

Ash Estimate

The percentage of ash was estimated by infusing the milk samples with the Muffle furnace and at 525 ° C for 16 hours and obtaining the white ash as described. [13]. Fat % Determination of fat content in infant milk formulas according to the Kerber method described by [14].

Protein Determination

Total Nitrogen (TN) was estimated using [14] and using the German-made microprocessor (Behrotest .2) of the College of Food Sciences / University of Al-Qasim Green, according to the instructions attached to the device. The total protein was then quantified by multiplying the total nitrogen fraction (TN) in model X 6.25, a nitrogen conversion factor [15].

Nitrogen distribution in recovered milk Nitrogen Distribution in Milk

Nitrogen distribution in milk was determined by method [16] as follows:

- **Determination of non-casein nitrogen** (NCN) determined Nitrogen content in whey (acidic) after acid deposition of casein at pH (pH = 4.6).
- **Determination of non-protein nitrogen** (NPN) in leachate resulting from milk treatment with trichloroacetic acid (TCA) 24% by (1: 1).
- **Casein protein** (CP) proteins are calculated from the following equation:

Casein proteins (CP) = Total Nitrogen (TN) Non-Casein Nitrogen (NCN

Carbohydrates (%): Carbohydrates were estimated by arithmetic method, as reported in [14]. Carbohydrates% = 100% (ash + protein + fat + moisture).

Lactose Estimate (Lactose %)

The lactose ratio was estimated in the infant formula according to the weight method described by [17] and based on the lactose reduction of Cu2O copper oxide under specific conditions. The reduced amount of copper Cu2O is proportional to the lactose content in the milk.

Calculation of the Amount of Energy

The amount of energy provided by infant formula was calculated according to the formula cited by the Nutrition Coordination Center (NCC) of the University of Minnesota [18].

Energy (kcal / 100 ml) = Protein% × 4.27 +% Fat × 8.79+% Carbohydrates × 3.87

Sensory Assessment

Sensory tests of infant milk formulas were conducted in the Department of Food Science, College of Agriculture, University of Kufa and College of Food Sciences, Al-Qasim GreenUniversity, by ten specialized professors according to the sensory evaluation form, which included the appearance of the box and the appearance of milk powder The texture and texture of milk recovered and the taste and smell of milk recovered [19].

Sensory Assessment by Mothers

A sensory evaluation was carried out by 14 mothers of female teachers and female employees at the College of Agriculture according to the 9-point hedonic test, as indicated by [20], which sets the lowest score of (1) for option (1) I like Final Dislike Extremely and (9) ratings for the option (I like it very much). It is designed to measure the admissibility of infant formula by mothers and does not require prior training on the basis of sensory assessment. Where the qualities of color, flavor (smell and taste), tissue and textures were evaluated, general acceptance of milk recovered.

Statistical and Analysis Data

The statistical analysis program GenStat V.12.1 [21] was used. The statistical analysis of the total composition of milk formulas was performed according to the complete random design (CRD). For the analysis of the results of the sensory evaluation, full random sector design (RCBD) was used. Duncan's Multiple Range test [22] was then compared to the probability level ($p \leq 0.05$) to determine the differences between the averages.

Results and Discussion

Total composition of infant milk formula and the amount of energy processed: Table (1) shows the amount of energy processed and the main nutrient ratios obtained by the infant from the milk formulaunder study. It was observed that the energy processed by the first-age formula Nactalia1 and Evolac1 were 67.04 and 66.71 kg / 100 ml, respectively, within the minimum of the mother's mother, which ranged from 66_69 kg / 100 ml [23]. The energy processed by Dielac1 milk was 65.48 kg / 100 ml and was not enough to cover the infant's daily nutritional requirements compared with the mother's energy. As for the milk formula of the second age, Dielac2 milk was equipped with a capacity of 67.19 kg / 100 ml which is equal to the energy provided by the mother's milk while the energy processed by the milk formula Celia2 and Sunnybaby2 63.27 and 65.78 kg / 100 ml respectively less than the minimum Which is equipped with breast milk for the infant.

This is consistent with Al-Jabari's findings [24] indicating that insufficient energy is provided by some infant formula to cover the daily nutritional requirements of infants. The table also indicates the differences in the proportions and quantities of total protein depending on the type and composition of the formula and may be due to the objective for which it was made. The first-generation formula (intended for feeding Infant from birth to 6 months old), Nactalia1, Dielac1 and Evolac1, were observed to have 10.98, 14.47 and 11.62 g / 100 g powdered milk powder respectively and 1.550, 1.88 and 1.85. 637 g/100 ml, respectively.

It was the highest protein in Dielac1 milk at 14.47 g / 100 g (1.88 g / 100 ml). Milk formula manufactured in the second age group (for feeding Infant over 6 months of age), Celia2, Dielac2 and Sunny baby2, had protein content of 15.23, 17.55 and 16.50 g / 100 g powdered milk powder respectively. 2.08, 2.605 and 2.242 g / 100 ml milk recovered respectively. The highest protein content in these formulas was in Dielac2 milk (17.55 g / 100 g powdered milk powder) (2.605 g / 100 ml recovered milk). The amounts of protein processed by these formulas exceeded the quantities supplied by the mother to the infant, amounting to 1.3 g / 100 ml [23].

This is in line with the findings of Abood [25], who reported that the ratio of protein processed by milk formula for the first age group ranged from 1.6 to 1.8, which exceeded the needs of the child at this stage. As consistent with the results AL-Talib & Manki [26] found statistically significant differences between mean values of all values when comparing the amount of protein processed by some infant formula available in the Iraqi market and the amount of dietary reference reference (DRIs) Dietary Reference Intakes.

The European Food Safety Authority (EFSA) [27] has also shown that high protein levels

in milk formula for the 2-year-old infant formula may increase kidney stress and negatively affect Infant development and growth.

Table 1: The amount of energy and the composition of Infant milk formula under study and the composition of breast milk

Material	Units	First- age infant formulas			second- age infant formulas			*breast milk g/100ml.
		Nactalia1	Dielac1	Evolac1	Celia 2	Dielac 2	Sunnybaby2	
Energy	kcal/100ml.	**67.04 ±0.431 cd**	**65.48 ±0.634 b**	**66.71 ±0.265 bcd**	**63.27 ±0.193 a**	**67.19 ±0.503 d**	**65.78 ±0.331 bc**	**66 _ 69**
Protein %	g/100g	**10.98** ±0.453 a	**14.47** ±0.278 b	**11.62** ±0.435 a	**15.23** ±0.311 b	**17.55** ±0.160 d	**16.50** ±0.357 c	_
	g/100ml.	**1.558** ±0.0144 a	**1.88** ±0.0354 c	**1.637** ±0.0197 b	**2.08** ±0.0197 d	**2.605** ±0.028 f	**2.242** ±0.0338 e	**1.3**
Fats %	g/100g	**23.07** ±0.668 b	**23.30** ±0.615 b	**22.80** ±0.216 b	**20.20** ±0.385 a	**19.62** ±0.384 a	**20.32** ±0.214 a	_
	g/100ml.	**3.184** ±0.0921 b	**3.145** ±0.0832 b	**3.121** ±0.0116 b	**2.727** ±0.0520 a	**2.826** ±0.0554 a	**2.865** ±0.0301 a	**3.4_4.1**
Carbohydrate %	g/100g	**60.70** ±0.809 c	**57.06** ±0.502 ab	**60.50** ±0.264 c	**58.23** ±0.548 b	**56.07** ±0.167 a	**56.91** ±0.360 ab	_
	g/100ml.	**8.374** ±0.111 d	**7.703** ±0.0691 a	**8.343** ±0.0366 d	**7.86** ±0.0733 ab	**8.07** ±0.0248 c	**8.018** ±0.0507 bc	**7.2_7.3**
Lactose %	g/100g	**40.45** ±0.206 d	**37.77** ±0.0595 a	**39.73** ±0.0785 c	**42.65** ±0.0526 e	**38.75** ±0.0456 b	**42.64** ±0.0538 e	_
	g/100ml.	**5.58** ±0.0292 c	**5.099** ±0.0007 a	**5.48** ±0.01 b	**5.75** ±0.0070 d	**5.598** ±0.0180 c	**6.008** ±0.0075 e	**6 _7.1**
Ash %	g/100g	**2.213** ±0.0686 b	**2.067** ±0.0776 ab	**2.010** ±0.00408 a	**3.362** ±0.0315 c	**3.435** ±0.0575 cd	**3.538** ±0.0239 d	_
	g/100ml.	**0.305** ±0.00925 b	**0.28** ±0.00987 a	**0.277** ±0.00062 a	**0.454** ±0.00415 c	**0.494** ±0.00839 d	**0.499** ±0.00328 d	**0.2**
Moisture %	g/100g	**3.040** ±0.101 b	**3.095** ±0.0260 b	**3.070** ±0.0246 b	**2.955** ±0.0107 b	**3.317** ±0.0214 c	**2.733** ±0.0135 a	_
	g/100ml.	**86.579** ±2.544 a	**86.992** ±0.0673 a	**86.622** ±0.0533 a	**86.879** ±0.0486 a	**86.005** ±0.0495 a	**86.376** ±0.0798 a	_

*Source: Crawley and Westland, (2016)

Values expressed as mean (±) standard error. The averages followed by different small letters within the same row indicate a significant difference at the probability level ($p \leq 0.05$)

The fat ratios in the milk formula of the first age group Nactalia1, Dielac1 and Evolac1 were 23.07, 23.30 and 22.80 g / 100 g. The fat percentage in the infant milk formula of the second age group was Celia2, Dielac2, Sunny baby2 20.20, 19.62 and 20.32 g / Powder milk powder respectively. It is an approach to lipid ratios in the milk formula Dielac 2 and Kicose 1 indicated by Ayed [28] which ranged from 17.8 to 23.20 g / 100 g, respectively. In the first milk formula, Nactalia1, Dielac1, Evolac1, and Celia2, Dielac2 and Sunny baby2 were 3.184, 3.145, 3.121, 2.727, 2.826 and 2.865 g / 100 ml respectively. These results differ from those of Fleddermann et al. [29] who reported that the fat content in infant milk formula ranged from 3.3 to 3.6 g / 100 ml. This may be due to the quality of the milk formula being studied and processed by Hipp GmbH & Co. KG. Vertrieb KG in Germany. The highest fat content was found in Nactalia1 milk, which was 3.184 g / 100 ml, which was lower than the minimum fat in mother's milk, 3.4 mg / 100 ml [23]. This is consistent with Al-Jabari [24] that the proportion of fat in the milk formulas of

Nectalia, Biomile, Dialac, Semilak, Health and Novalac was less than recommended by the World Health Organization. He also agrees with Abood et al. [30] that infant formula (Al-Badia, Materna, Dielac, and Lailac) is not suitable for infant feeding in terms of fat intake and the imbalance of saturated and unsaturated fatty acids.

Carbohydrates were 60.70, 57.06, 60.50, 58.25, 56.07 and 56.91 g / 100 g for Nactalia1, Dielac1, Evolac1, Celia2, Dielac2 and Sunny baby2 respectively. The percentage of carbohydrates in milk recovered from these formulas ranged from 8.374, 7.703, 8.343, 7.86, 8.07 and 8.018 g / 100 ml, respectively. As these ratios are higher than the percentage of carbohydrates provided by breast milk for the infant 7.2_7.3 mg / 100 ml [23]. Carbohydrate in milk Nactalia1 was the highest 8.374 g / 100 ml, so carbohydrates provide enough energy for the baby so that the body does not have to destroy fat and use it as a source of energy, which increases the accumulation of intermediate products such as ketones causes the rise of acidity of blood Ketosis [26].

As the baby needs more energy during the first months of life in order to maintain the growth and activity of the body and maintain its functions [31]. It was also observed that the proportion of lactose sugar in powdered milk powder for Nactalia1 formulas, Dielac1, Evolac1, Celia2, Dielac2 and Sunny baby2 were 40.45, 37.77, 39.73, 42.65, 38.75 and 42.64 g / 100 g, respectively. In recovered milk 5.58, 5.099, 5.48, 5.75, 5.598 and 6.008 g / 100 ml, respectively. The highest percentage of lactose sugar in the milk of Sunny baby2 was 6.008 g / 100 ml and was equal to the minimum lactose given by the mother to her infant 6 7.1 g / 100 ml [23].

Other milk formulas have less lactose content. This may be due to the modulation of cows' milk by manufacturers, as cow's milk with low lactose content is 4.8 g / 100 ml [32]. Some companies add other carbohydrates such as glucose, maltose, and maltodextrin instead of lactose as a source of carbohydrates [33]. To achieve the required amount of energy with an acceptable level of sweetness. However, recent evidence suggests that dietary lactose enhances calcium absorption, and lactose-free diets lead to low calcium absorption [34] and calcium, which is also known to be a key component of bone and tooth formation.

Table 1 shows the ash ratios for Nactalia1, Dielac1, Evolac1, Celia2, Dielac2 and Sunny baby2, which ranged from 2.213, 2.067, 2.010, 3.362, 3.435 and 3.538 g / 100 g, respectively. When comparing the percentage of ash in the milk recovered from the same milk formulas with breast milk, it is higher than in the milk of 0.2 g / 100 ml [23]. Where it ranged from 0.305, 0.28, 0.277, 0.454, 0.494, 0.499 g / 100 ml, respectively.

This may be due to iron fortification processes and other mineral elements such as calcium and phosphorus due to their low absorption and bioavailability in infant formula compared to the bioavailability of mineral elements in breast milk [15]. Minerals perform various physiological functions within the body. Martin et al. [35] stated that mineral elements form essential parts of many enzymes and contribute to the synthesis of molecules, biochemical structures, tissues, etc. However, excessive mineralization may negatively affect the health and development of the child. Increased iron may reduce the absorption of copper, which affects the immune system of the infant.

Al-Jabari [24] indicated that the availability of mineral elements in greater quantities than infant needs may cause long-term accumulation of liver and kidneys. High calcium levels in milk also increase blood concentration, causing kidney damage. The high calcium / phosphorus ratio causes an increase in blood calcium due to bone dissolution, leading to early osteoporosis. Table 1 also shows the moisture content of powdered milk powder for Nactalia1, Dielac1, Evolac1, Celia2, Dielac2 and Sunny baby2 formulas, which ranged from 3.040, 3.095, 3.070, 2.955, 3.377 and 2.733 g / 100 g, respectively.

These results are consistent with what Ayed [28] reported on the moisture content of powdered milk ranging from 2.8% in dialac milk to 4.0% in powdered milk. The humidity ratio in the milk of Dielac2, the highest was 3.377 g / 100 g, which differed significantly from the rest of the milk formulas under study at the probability level ($p \leq 0.05$). The humidity in Sunny milk2 was 2.733 g / 100 g. While there were no significant differences between other milk models at the same risk level. El Khier et al. [36] reported that the persistence of physical properties of powdered

milk powders can be affected by different moisture content during storage and distribution processes. Harfouch et al. [37] stated that moisturizing content is the most important factor in determining the speed of unwanted changes in powdered milk. However, very low moisture content may increase the self-oxidation rate of saturated fat significantly.

Comparison of Total Composition in Infant Milk Formulas with Some of Standard Specifications

Table 2 shows the main nutrients in milk formulas calculated per 100 kilocalories and the amount of energy they are prepared to compare with the Iraqi standard and some international standards. The results showed that milk formulas Nactalia1, Dielac1 and Evolac1 processed a calorie intake of 67.04, 65.48 and 66.71 g / 100 ml, respectively. Which is equal to the amount of energy that ranges between 60-70 kcal / 100 ml and defined by the English standard for the first age [23] Gulf Standard GSO05/FDS2106/2015 for the infant formula manufactured by the Standardization Organization for the Arab States of the Gulf [38].

However, the Iraqi Standard No. 1094 on infant formula substitutes for breast milk issued by the Central Agency for Standardization and Quality Control [39] did not specify the amount of energy to be prepared for the child by formulas of the first age group within the basic requirements. The amount of energy processed by the milk formulas Celia2, Dielac2 and Sunny baby2 was 63.27, 67.19 and 65.78 kg / 100 ml, respectively. They are within the range of energy specified by the English [23] and Iraqi [40]. It should be noted that the Iraqi standard No. 2105 for the second-age Infant food issued by the Central Iraqi Organization for Standardization and Quality Control [40] has set an energy range of 60 to 85 Kg / 100 ml which is wider than the energy range specified by the English standard for the stage the second age is 60 kg / 100 ml [23].

Table 2 shows that protein content in milk formulas Nactalia1, Dielac1, Evolac1, Celia2, Dielac2 and Sunny baby2 were 2.324, 2.87, 2.454, 3.288, 3.877 and 3.408 g / 100 kg respectively. Although these percentages fall within the limits of all standards, they are high for use by Infant in Iraq.

Which is characterized by high temperatures in summer and accompanied by an increase in the rate of sweating processes where increased losses of water outside the body. With increased protein intake in infants without intake of fluids from other sources, the water balance in the body will be affected. Mikhael [41] that the hot weather and lack of electricity in Iraq during the summer lead to an increased risk of loss of fluids through sweating, resulting in water imbalance in the body.

Table 2: The main nutrients in infant formulas per 100 kcal compared with some standard specifications

	Gulf standard	First age	60_70	1.8 _ 3	4.4 _ 6	9 _ 14 *	N/S	
	English standard	second age	60_70	1.8_3.5	4_ 6	9 _ 14	4.5_ N/S	
		First age	60_70	1.8 _ 3	4.4 _6	9 _ 14 *	4.5_ N/S	
	Iraqi standard	second age	60_85	3 _5.5	3 _6	N/S	N/S	
		First age	N/S	1.8_4	3.3 _6	N/S	N/S	

-N / S = not stated Source: Crawley and Westland, (2016).
- Values expressed as mean (±) Standard error.
- The averages followed by different lowercase letters in one row indicate a significant difference at the probability level ($p \leq 0.05$).

	second- age infant formulas		**Sunny baby2**	**65.78 ± 0.331 bc**	**3.408 ± 0.111 e**	**4.355 ± 0.0431 a**	**12.19 ± 0.0566 abc**	**9.133 ± 0.0557 c**	
			Dielac2	**67.19 ±0.503 d**	**3.877 ± 0.0192 f**	**4.212 ± 0.0462 a**	**12.01 ± 0.126 ab**	**8.331 ± 0.0399 b**	
			Celia2	**63.27 ±0.193 a**	**3.288 ± 0.0347 d**	**4.309 ± 0.0732 a**	**12.42 ± 0.131 bc**	**9.088 ± 0.0302 c**	
	First- age infant formulas		**Evolac1**	**66.71 ±0.265 bcd**	**2.454 ± 0.0230 b**	**4.678 ± 0.00729 b**	**12.51 ± 0.0375 c**	**8.214 ± 0.0254 b**	
			Dielac1	**65.48 ±0.634 b**	**2.87 ± 0.0261 c**	**4.81 ± 0.0767 b**	**11.77 ± 0.211 a**	**7.789 ± 0.0772 a**	
			Nactalia1	**67.04 ±0.431 cd**	**2.324 ± 0.0366 a**	**4.747 ± 0.111 b**	**12.49 ± 0.221 c**	**8.323 ± 0.0235 b**	
	----			**Energy** kcal/100ml .	**Proteins** g/100 kcal	**Fats** g/100 kcal	**Carbohydrate** g/100 kcal	**Lactose** g/100 kcal	

AL-Talib & Manki [26] also reported that the protein that is excess of the body's needs results in an increase in metabolites of the dissolved salts accumulated in the body. This increases the load on the kidneys to get rid of them. Therefore, may lead to hypersensitivity Hypernatremia, especially in the incidence of diarrhea and the occurrence of droughts, especially during the first six months of life. The risk is increased when the milk formulas are prepared with intensive, non-diluted milk.

It was also observed that the fat ratios in the infant milk formulas Nactalia1, Dielac1, Evolac1, Celia2, Dielac2 and Sunny baby2 ranged from 4.747, 4.81, 4.678, 4.309, 4.212 and 4.355 g / 100 kcal, respectively. They are all in accordance with the Iraqi and English standards for the first and second stages and the Gulf standard for the first age [39, 40, 23, 38]. The ratio of carbohydrates to the milk formulas themselves was 12.49, 11.77, 12.51, 12.42, 12.01 and 12.19 g / 100 kcal respectively. Lactose levels ranged from 8.323, 7.789, 8.214, 9.088, 8.331 and 9.133 g / 100 kg, respectively.

These percentages correspond to the levels set by the English and Gulf [23, 38]. The Gulf standard sets strict control on the proportion of carbohydrates, especially lactose, which emphasizes the need to use lactose as a main source of carbohydrates and does not allow the addition of more than 30% of total carbohydrates as other alternatives to lactose to be free of gluten. It prevents the addition of sucrose and fructose to infant formula [38]. However, the Iraqi standard did not specify clearly the amount of carbohydrates and the proportion of lactose sugar to be available in infant milk formulas.

The indication card for milk formulas 1Dielac and Dielac2 contains refined sugar which, when analyzed, is a source of fructose sugar. Note that all international organizations concerned with child health prevent its use in infant formula in the first age. Due to the acute adverse effects that include sudden infant death from Genetic fructose intolerance, which is difficult to identify and diagnose [15].

This is consistent with Mikhael [9] on the need not to market these types of milk in

Iraq as formulas for feeding infants under the age of six months.

Nitrogen Distribution in Infant Formula

The protein content of infant formula should be similar to that of breast milk, ranging from 0.9 to 1.7 g protein / 100 g of ready-to-drink milk. Some companies may increase this percentage if buffalo milk or cow's milk is used in the preparation of these formulas. Due to the low value of the proteins of cow's milk and buffalo, which consists mostly of casein compared with breast milk, which is high in the proportion of proteins shark. The casein proteins have a lower biological value than the shark proteins. α- lactalbumin, the predominant protein in breast milk, is one of the most valuable milk proteins in terms of biological value, ease of digestion and absorption [43]. Table (3) shows the nitrogen distribution in the Infant milk formulas under study compared with breast milk and cow's milk. The results indicate that the proportions of the shark proteins to the casein differ in the six milk formulas under study. The percentage of whey protein/ casein in the infant milk formulas Nactalia1, Dielac1, Evolac1, Celia2, Dielac2 and Sunny baby2 was about 52/36, 17/74, 20/71, 25/67, 16/77 and 48/44, respectively. It is noted that the percentage of shark proteins represent about 17%, 20% and 16% in the formulas Deilac1, Evolac1 and Deilac2, respectively.

Table 3: Nitrogen distribution in milk recovered from infant milk formulas compared to breast milk and cow milk

Samples	Total proteins	Casein proteins		Whey proteins		NPN	
	g/100g	g/100g	%	g/100g	%	g/100g	%
Nactalia1	1.558 ± 0.0144	0.564 ± 0.0193	36.12%	0.815 ± 0.0121	52.25%	0.179 ± 0.00185	11.54%
Deilac1	1.88 ± 0.0354	1.39 ± 0.0406	73.93%	0.319 ± 0.00902	17.02%	0.172 ± 0.00294	9.04%
Evolac1	1.637 ± 0.0197	1.167 ± 0.0326	71.16%	0.319 ± 0.0147	19.63%	0.152 ± 0.00147	9.2%
Celia2	2.08 ± 0.0171	1.394 ± 0.0120	66.82%	0.52 ± 0.0120	25%	0.166 ± 0.00506	7.98%
Deilac2	2.605 ± 0.0287	2.007 ± 0.0319	76.92%	0.413 ± 0.0138	15.77%	0.184 ± 0.000854	7.07%
Sunnybaby2	2.242 ± 0.0338	0.992 ± 0.0448	44.19%	1.069 ± 0.0215	47.76%	0.182 ± 0.00606	8.03%
Breast milk*	0.9 – 1.7	0.32 - 0.42	26.06%	0.68-0.83	53.52%	0.26-0.32	20.42%
Cow milk*	3.1-3.8	2.46-2.80	77.23%	0.55-0.70	17.54%	0.1- 0.19	5.23%

- Values are expressed as mean (±) standard error.
- *Guo et al., (2007)

It is an approach to the proportion of whey proteins in the milk of cattle that was used in their preparation, which is 17.5% [42]. But we find this percentage rises to 25% in the milk of Celia2 and up to about 48% and 52% in the milk formulas Sunny baby2 and Nactalia1, respectively. To close to the level of protein shark proteins in breast milk, this represents 53.5% of the total protein [42]. Non-protein nitrogen ratio (NPN) differences in the infant milk formulas under study were also observed, ranging from 7-11% of total nitrogen. 11.44%, 9.04%, 9.2%, 7.98%, 7.07% and 8.03% milk formulas Nactalia1, Dielac1, Evolac1, Celia2, Dielac2 and Sunny baby2, respectively.

The highest percentage (NPN) in Nactalia1 milk, which amounted to 11.54% of total nitrogen. Although non-protein nitrogen ratios were higher in these formulas compared to their percentage in cow's milk, which contained 5.23% non-protein nitrogen. But it is still lower than in the mother's milk, which is 20.42% of total nitrogen [42]. NPN in breast milk contains many ingredients that play exceptional roles in promoting the growth and development of newborns such as peptides, free amino acids, growth factors, hormones and sleepy peptides [44].

Results of Sensory Evaluation of Infant Formula

Sensory Evaluation by Experts

Dharam et al. [19] explained that powdered milk has many sensory, physiochemical and recoil properties that are important for both the plant and the consumer. These characteristics are the basic elements of the quality specifications of powdered milk powders. Therefore, all precautions should be taken during the drying process to maintain as much of the natural characteristics of the original raw milk. Dried products must be of high quality when re-reclaimed with water

and should not provide evidence of undesirable changes compared to the original liquid products. Evaluation of powdered milk powders based on their sensory properties plays an important role in consumer acceptance. Table (4) shows the results of the sensory evaluation of infant formula under study by a group of expert professors in food and dairy sciences. The results showed a significant superiority in the appearance of the box in the milk formulas of Celia2 and Sunny baby2, with a rating of 4.6 and 4.8 respectively.

As it differed significantly from Evolac 1 milk. At a probability level ($p \leq 0.05$) that received the lowest rating of 3.9 for the box appearance. While not significantly different with the remaining milk formulas under study at the same risk level. As for the appearance of milk powder, there was a significant decrease in the levels of Evolac1 milk, which obtained 10.20 degrees compared to the other formulas milk Nactalia1, Dielac1, Celia2, Dielac2 and Sunny baby2, which got 13.10, 12.00, 13.40, 13.00 and 13.13 degrees, respectively.

Table 4: Results of sensory evaluation of infant milk formulas under study by specialized professors

Stage	samples	Package Appearance 3 - 5	Appearance of Dry product 9 -15	Appearance of reconstituted milk 9 - 15	Body and texture of reconstituted milk 17 - 20	Flavour of reconstituted milk 27 - 45	Acceptability 65 - 100
First- age infant formulas	Nactalia1	**4.5** ± 0.167 **ab**	**13.10** ± 0.433 **b**	**13.50** ± 0.224 **a**	**16.50** ± 0.687 **a**	**33.30** ± 2.226 **a**	**80.90** ± 3.060 **a**
	Deilac1	**4.2** ± 0.291 **ab**	**12.00** ± 0.730 **b**	**12.50** ± 0.453 **a**	**15.60** ± 0.909 **a**	**34.30** ± 2.246 **a**	**78.60** ± 4.088 **a**
	Evolac1	**3.9** ± 0.277 **a**	**10.20** ± 0.757 **a**	**12.40** ± 0.748 **a**	**16.00** ± 1.022 **a**	**34.50** ± 2.339 **a**	**77.00** ± 4.107 **a**
Second- age infant formulas	Celia2	**4.6** ± 0.163 **b**	**13.40** ± 0.427 **b**	**13.30** ± 0.448 **a**	**16.60** ± 0.792 **a**	**33.50** ± 3.045 **a**	**81.40** ± 4.293 **a**
	Deilac2	**4.3** ± 0.260 **ab**	**13.00** ± 0.83 **b**	**13.30** ± 0448 **a**	**16.60** ± 1.067 **a**	**37.00** ± 2.362 **a**	**84.20** ± 4.447 **a**
	Sunnybaby2	**4.8** ± 0.133 **b**	**13.30** ± 0.367 **b**	**13.00** ± 0.471 **a**	**16.70** ± 1.012 **a**	**32.80** ± 3.323 **a**	**80.60** ± 4.717 **a**

If any model obtains the minimum grade of any status, it is rejected.
Values expressed as mean (±) standard error. The averages of different letters within the same column indicate a significant difference at the probability level ($p \leq 0.05$)

The characteristics of the appearance of milk recovered, tissue and strength of milk recovered, taste and smell of milk recovered and general acceptance of milk did not notice significant differences at the same level of probability. Although Evolac1 had the lowest average acceptance rate of 77.00 degrees. While Dielac2 milk had the highest mean of 84.20 degrees. Dielac2 milk also had the highest average taste and odor status of 37.00 °, but these differences were not significant at ($p \leq 0.05$). Only it has Due to the addition of refined sugar with lactose as a source of carbohydrates, which is characterized by sweetness higher than the sweetness of lactose sugar [45].

Sensory Assessment by Mothers

Table (5) shows the results of the sensory evaluation of milk formulas under study by teaching mothers and female employees in the College of Agriculture - University of Kufa. There was no significant difference between milk formulas for color status at ($p \leq 0.05$). While Dielac2 milk significantly exceeded the average scores for odor status 7.70 on Nactalia1 and Sunnybaby2 milk formulas, which obtained the same minimum score of 6.20 for this characteristic at the same level of probability.

Table 5: Results of sensory evaluation by mothers of reconstituted milk from infant formulas

Stage	samples	Color 1 - 9	Flavour 1 - 9	Taste 1 - 9	texture 1 - 9	Acceptability 1 - 9	Summation 5 - 45
First- age infant formul	Nactalia1	**6.90** ± 0.407 **a**	**6.20** ±0.389 **c**	**5.80** ± 0.416 **b**	**6.40** ± 0.452 **b**	**6.80** ± 0.490 **b**	**32.10** ± 1.295 **b**
	Deilac1	**7.20**	**7.60**	**7.80**	**7.10**	**7.00**	**36.70**

		± 0.359 **a**	± 0.4 **ab**	± 0.327 **a**	± 0.379 **ab**	± 0.558 **b**	± 1.334 **ab**
	Evolac1	**7.10** ± 0.379 **a**	**7.20** ± 0.490 **abc**	**6.20** ± 0.827 **b**	**6.70** ± 0.396 **ab**	**7.20** ± 0.290 **ab**	**34.40** ± 1.984 **b**
Second- age infant formulas	**Celia2**	**7.30** ± 0.396 **a**	**7.00** ± 0.494 **abc**	**7.20** ± 0.533 **ab**	**7.40** ± 0.306 **a**	**7.70** ± 0.367 **ab**	**36.50** ± 1.635 **ab**
	Deilac2	**7.50** ± 0.5 **a**	**7.70** ± 0.567 **a**	**8.30** ± 0.396 **a**	**7.50** ± 0.477 **a**	**8.20** ± 0.389 **a**	**39.20** ± 2.205 **a**
	Sunnybaby2	**6.90** ± 0.623 **a**	**6.20** ± 0.467 **ab**	**6.80** ± 0.467 **ab**	**6.90** ± 0.348 **ab**	**7.00** ± 0.394 **b**	**33.80** ± 1.685 **b**

Values expressed as mean (±) standard error.
The averages followed by different letters within the same column indicate a significant difference at the probability level ($p \leq 0.05$)

The average grading scores for the Dielac 2 and Dielac1 milk formulas were highest, ie, 8.30 and 7.80, respectively, significantly different from Nactalia1 and Evolac 1 milk formulas, which had the lowest ratings of 5.80 and 6.20 degrees, respectively. The difference was not significant with the rest of the milk formulas at the same risk level. As for the tissue and textures and general acceptance recipe, Dielac2 milk was obtained at 7.50 and 8.20 degrees respectively. Nactalia1 was the lowest with 6.40 and 6.80 degrees respectively. The increase in the sensory properties of Dielac2 milk may be due to the low ratio of shark / casein protein 16/77 and non-protein nitrogen (NPN) table (3) as well as the addition of refined sugar with lactose as a source of carbohydrates. While the decrease in sensory properties in Nactalia1 milk may be due to the high proportion of protein shark / casein 52 \ 36 as well as (NPN).

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