


# Comparison of the Nutritional Values of Infant Formulas Available in Saudi Arabia

Global Pediatric Health  
Volume 4: 1–7  
© The Author(s) 2017  
Reprints and permissions:  
sagepub.com/journalsPermissions.nav  
DOI: 10.1177/2333794X17731037  
journals.sagepub.com/home/gph  


**Abdulhadi Hesn Almazrooy, PhD<sup>1</sup>, Abdulrahman Mohammad Alturki, MBBS<sup>1</sup>, Afaf Mubarak Aljohani, MBBS<sup>1</sup>, Abeer Alraddadi, MBBS<sup>1</sup>, and Abdulrahman Muslim Allogmani, MBBS<sup>1</sup>**

## Abstract

**Introduction.** Optimum growth and development are best achieved by breastfeeding, which is the safest source for infant feeding. Mothers in Saudi Arabia start to breastfeed their infants but soon introduce formula brands. **Objective.** To assess the safety and nutritional adequacy of the oldest formula brands available in the Saudi market. **Methods.** An observational study has compared between 5 types of infant formula brands; they were chosen based on their international popularity. Also, they are considered as the oldest formula brands available in the Saudi market. The contents of all the included formulas were carefully collected from their containers. The collected data were compared with the global standard requirements for infant formulas according to the guidelines. **Results.** All the infant formula brands had their contents within the optimal range as stated by the ESPGHAN (European Society for Paediatric Gastroenterology, Hepatology and Nutrition) guidelines. Some formulas did not provide elements like fluoride and nucleotides. Moreover, the mandatory elements and the most dominant ingredient in each formula were documented. **Discussion.** According to the results of our study, all included formula brands are considered safe and nutritionally adequate. By assuming that the elements that were not found in some brands meant an abnormal value, Bebelac and Liptomil are the most suitable infant formulas available in the Saudi market. **Conclusions.** Adequate nutrition during infancy is essential in each health organization. The nutritional status of infants should be studied to achieve lifelong health and well-being. All formula brands in this study were found to be safe and nutritionally adequate.

## Keywords

brands, formula, infant health, nutrition

Received July 21, 2017. Accepted for publication August 8, 2017.

## Introduction

The first 2 years of a child's life provides a critical window of opportunity for ensuring appropriate growth and development through optimal feeding.<sup>1</sup> Optimum growth and development is best achieved by breastfeeding, which is the safest source for infant feeding.<sup>2</sup> Mothers in Saudi Arabia usually start to breastfeed their infants but soon introduce formula brands, and insufficient breast milk was identified as the most common reason for this early introduction of formula brands.<sup>3</sup> In some cases, mothers are unwilling to breastfeed their infants because of their busy work schedule, because of some medical conditions, or due to breastfeeding difficulties.<sup>2,4,5</sup> It is very critical to

select the suitable formula based on the infant's medical condition and the infant's individual needs, after all formula milk is not as adequately safe as natural breast milk.<sup>4,6</sup> Due to the large number of advertisements for infant formulas, and due to the various types of formulas that are widely available in the Saudi market, the appropriate choice of formula has been very difficult and confusing to both parents and physicians.<sup>7,8</sup> This

<sup>1</sup>Taibah University, Madinah, Al Madinah, Saudi Arabia

### Corresponding Author:

Abdulrahman Mohammad Alturki, Taibah University, Medical College, Medina, Second Ring, Madinah 00966, Saudi Arabia.  
Email: dr.amaat93@gmail.com



**Table 1.** Formulas' Macronutritional, Taurine, and L-Carnitine Contents Compared With the ESPGHAN Standards.

Parameter	Similac	S26 GOLD	Liptomil	Bebelac	NAN	ESPGHAN Guidelines
Energy (kcal/dL)	64.2	67	65	65	67	60-70
Protein (g/100 kcal)	2.18	1.94	2.15	2	1.85	1.8-3
Lipid						
Total fat (g/100 kcal)	5.45	5.37	5.38	5.08	5.33	4.4-6
Linoleic acid (g/100 kcal)	0.95	0.776	0.92	0.69	0.82	0.3-1.2
$\alpha$ -Linolenic acid (mg/100 kcal)	77.88	62.69	153.85	126.15	91.04	50 to not specified
Arachidonic acid (mg/100 kcal)	3.27	17.91	0.0106	9.85	11.79	Should be at least equal to DHA content (optional)
Docosahexaenoic acid (mg/100 kcal)	3.27	10.6	10.62	9.85	11.79	0% to 0.5% of total fat (optional)
Carbohydrates						
Total carbohydrate (g/100 kcal)	10.4	10.9	10.46	11.38	11.15	9-14
Taurine (mg/100 kcal)	6.96	7.01	5.85	8.15	7.61	0-12 (optional)
L-Carnitine (mg/100 kcal)	1.28	1.49	2	2.46	1.8	1.2 to not specified

Abbreviations: ESPGHAN, European Society for Paediatric Gastroenterology, Hepatology and Nutrition; DHA, docosahexaenoic acid.

study was conducted on the most commonly available milk formulas to evaluate the nutritional adequacy and the safety of each formula and to compare between these formula brands accordingly.

## Objectives

This study aims to assess the safety and nutritional adequacy of the oldest formula brands available in the Saudi market.

## Methodology

This observational study was conducted in Madinah, Saudi Arabia, during March to April 2017. This research involved a comparison between 5 types of infant formula brands (nonspecially designed cow's milk-based formulas) that are designed and marketed for feeding infants under 12 months of age; the formulas were chosen based on their international popularity. In addition, they are considered as the oldest formula brands available in the Saudi markets, NAN from Nestle since 1860, Bebelac from Nutricia since 1896, Liptomil from Liptomil since 1908, S26 GOLD from Wyeth since 1960, and Similac from Abbott since 1988. The composition of all the included formulas were carefully collected from the information written on the formulas' containers. The collected ingredients of the included formulas were accurately documented using Microsoft Word 2010. Both macro and micronutrient contents of each type of formula—energy, protein, lipid, carbohydrate, vitamins, and minerals—were expressed as the amount per 100 kcal of formula milk in one combined table by similar

nutritional units for each ingredient labeled. The collected data were then compared with the global standard requirements for infant formulas according to the guidelines of The European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN).<sup>9</sup> The ESPGHAN represents an optimal range of value for each nutrient, and these values indicate the normal range for safety and adequacy; so if a value does not fall within the normal range, it will consequently be represented as an abnormal value according to our guideline (the ESPGHAN).

## Results

In Tables 1, 2, and 3, we can find that all the included infant formula brands (NAN, Bebelac, Liptomil, S26 GOLD, and Similac) had their contents within the optimal range as stated by the ESPGHAN guidelines. However, Similac did not have the following ingredients documented: fluoride and nucleotides. Both S26 GOLD and NAN formulas did not have fluoride included in their ingredients. However, both Liptomil and Bebelac formulas were found to have all the elements mentioned in the ESPGHAN guidelines. Nevertheless, the contents of all the 5 infant formulas were within the optimal range according to the ESPGHAN guidelines. Table 4 shows the mandatory elements included in each formula.

Regarding proteins, all the included formulas in our research had whey as the most dominant protein. Furthermore, it was found that S26 GOLD, Liptomil, and Bebelac have included casein in their formula composition. Only S26 GOLD has included  $\alpha$ -lactalbumin.

**Table 2.** Formulas' Mineral Contents Compared With the ESPGHAN Standards.

Parameter	Similac	S26 GOLD	Liptomil	Bebelac	NAN®	ESPGHAN Guidelines
Ca (mg/100 kcal)	78.04	62.69	69.23	87.69	64.18	50-140
P (mg/100 kcal)	42.37	35.82	43.08	49.23	35.82	25-90
Mg (mg/100 kcal)	9.36	6.72	7.85	7.85	8.51	5-15
Na (mg/100 kcal)	27.73	23.88	29.23	26.15	25.37	20-60
K (mg/100 kcal)	123.05	97.01	103.08	104.62	101.49	60-160
Cl (mg/100 kcal)	61.53	64.18	58.46	64.62	70.15	50-160
Zn (mg/100 kcal)	0.78	0.90	0.92	0.8	1.04	0.5-1.5
Fe (mg/100 kcal)	1.12	1.19	1.08	0.82	1	0.3-1.3
Cu (µg/100 kcal)	78.97	49.25	69.23	61.54	77.61	35-80
Mn (µg/100 kcal)	20.56	7.46	11.85	12	19.40	1-50
I (µg/100 kcal)	20.56	14.93	13.85	18.46	19.40	10-50
Se (µg/100 kcal)	1.71	2.09	1.38	2.31	2.54	Up to 9
Fluoride (µg/100 kcal)	—	—	9.85	≤3	—	Not specified to 60

Abbreviation: ESPGHAN, European Society for Paediatric Gastroenterology, Hepatology and Nutrition.

**Table 3.** Formulas' Vitamin and Nucleotide Contents When Compared With the ESPGHAN Standards.

Parameter	Similac	S26 GOLD	Liptomil	Bebelac	NAN®	ESPGHAN Guidelines
A (IU/100 kcal)	256.39	328.36	327.69	282	338.21	200-600
D <sub>3</sub> (IU/100 kcal)	74.45	71.64	67.69	73.85	55.52	40-100
E (mg/100 kcal)	3.47	1.64	1.54	1.69	1.54	0.5-5
K (µg/100 kcal)	8.57	10	6.92	6.77	8.28	4-25
C (mg/100 kcal)	10.44	13.43	20	14.15	14.25	8-30
B <sub>1</sub> (µg/100 kcal)	124.61	149.25	89.23	78.46	111.94	60-300
B <sub>2</sub> (µg/100 kcal)	233.64	164.18	156.92	186.15	223.88	80-400
B <sub>6</sub> (µg/100 kcal)	62.31	82.09	89.23	58.46	70.15	35-175
B <sub>12</sub> (µg/100 kcal)	0.295	0.27	0.31	0.28	0.25	0.1-0.5
Niacin (µg/100 kcal)	1105.92	746.27	769.23	661.54	880.597	300-1500
Pantothenic acid (µg/100 kcal)	623.05	522.39	615.38	529.23	940.299	400-2000
Folic acid (µg/100 kcal)	14.797	16.42	15.38	20	14.25	10-50
Biotin (µg/100 kcal)	3.89	2.99	2.92	2.15	2.54	1.5-7.5
Choline (mg/100 kcal)	15.58	14.93	11.85	18.46	18.06	7-50
Nucleotide (mg/100 kcal)	—	3.88	4.92	4.92	3	0-5 mg (optional)

Abbreviation: ESPGHAN, European Society for Paediatric Gastroenterology, Hepatology and Nutrition.

Linoleic acid was found to be the most dominant type of fat in all the included formulas with the exception of Bebelac. All the formulas had linoleic acid,  $\alpha$ -linolenic acid, arachidonic acid, and docosahexaenoic acid. In addition to the previous elements, Liptomil had also included eicosa-pentaenoic acid in its formula composition. Moreover, Bebelac had saturated trans fatty acid as the most dominant type of fat. Bebelac has also included monounsaturated and polyunsaturated fatty acids in its formula.

All the included formulas had lactose as the most dominant type of carbohydrate. Furthermore, Bebelac has included glucose, galactose, lactose (most dominant), maltose, and polysaccharides.

## Discussion

According to the results of our study, all the included formula brands were found to be safe and nutritionally adequate. There is lack of the following ingredients: fluoride and nucleotides. In comparison with the ingredients found in the ESPGHAN guidelines, there are 2 elements that were not found in some of the formulas, which are fluoride and nucleotides. Both Liptomil and Bebelac formulas were provided with all the elements. S26 GOLD and NAN both had a lack of fluoride. Similac formula had a lack of both fluoride and nucleotides. By assuming that the elements that were not found in some brands meant an abnormal value, Bebelac and

**Table 4.** The Mandatory Elements Included in Each Formula.

Parameter	Similac	S26 GOLD	Liptomil	Bebelac	NAN
Protein	Whey	Whey Alpha-lactalbumin Casein	Whey Casein	Whey Casein	Whey
Fat	LA ALA AA DHA	LA ALA AA DHA	LA ALA AA DHA Eicosapentaenoic acid	LA ALA AA DHA Saturated trans fatty acid Monounsaturated acid Polyunsaturated fatty acid	LA ALA AA DHA
Carbohydrate	Lactose			Glucose Galactose Lactose (most) Maltose Polysaccharide	Lactose

Abbreviations: LA, linoleic acid; ALA,  $\alpha$ -linolenic acid; AA, arachidonic acid; DHA, docosaheptaenoic acid.

Liptomil are considered the most suitable infant formulas available in the Saudi market. According to the ESPGHAN guidelines, essential contents include energy, protein, lipid, carbohydrate, vitamins, and minerals. And optional contents are taurine, nucleotides, phospholipids, long-chain polyunsaturated fatty acids, and carrageenan.

### Protein

During the past 50 years, many studies have discussed the nutritional intake in full-term infants and the optimal protein-energy ratio and the safety and the consequences of infant milk formula feeding.<sup>10,11</sup> All 5 formulas (NAN, Bebelac, Liptomil, S26 GOLD, and Similac) have their protein-energy ratios as recommended by the ESPGHAN guidelines (Tables 1-3). All these infant formulas are manufactured from cow's milk; cow's milk formulas are of 2 groups: whey-dominant formulas, which are modified to contain a higher proportion of whey to casein to mimic to some extent that proportion of human milk that is more digestible. These formulas are recommended in the first 4 to 6 months. The second type is casein-dominant formulas, which are modified to have a higher proportion of casein than that of human milk, as casein needs longer time to be digested. Thus, it is suitable to feed a full-term baby and the hungry baby, up to 1 year of age. These formulas can be stressful to the young infant's immature organs, and they are recommended for infants from 3 to 6 months only.<sup>12</sup> Similac, Bebelac, S26 GOLD, and NAN are whey-dominant formulas while Liptomil is a casein-dominant formula (Table 4). Whey-dominant formulas when compared to casein-based protein formulas are

considered to be digested more easily and can enhance rapid gastric emptying.<sup>13</sup> Of all the included infant formulas, S26 GOLD is the only formula that contains  $\alpha$ -lactalbumin in addition to whey and casein (Table 4). Since newborns and infants are considered to be at higher risk of inadequate bioavailability of tryptophan, which is necessary for the optimal synthesis of serotonin in the brain,<sup>14</sup>  $\alpha$ -lactalbumin supplementation as a source of tryptophan can promote the neurobehavioral effects in adults,<sup>15</sup> and S26 GOLD formula is considered to have the best protein content quality.

### Fat

Infant formulas that include cow's milk lipids and milk fat membrane extracts were found to be more similar to the structure and composition of human milk.<sup>16</sup> However, the majority of infant formulas use vegetable lipids as they are much cheaper than cow's milk lipids. Similac, S-26 GOLD, Bebelac, and Liptomil have vegetable oils as their sole source of fat. NAN has both vegetable and animal sources of fat. Similac's vegetable sources of fat include high oleic sunflower oil, oil soy oil, coconut oil; S26 GOLD includes palm oil, high oleic sunflower oil, soybean oil, coconut oil; Liptomil includes palm oil, sunflower oil, rapeseed oil, coconut oil; Bebelac includes palm oil, sunflower oil, erucic acid, rapeseed oil, coconut oil, and single cell oil; and NAN includes palm olein, sunflower oil, low erucic acid, rapeseed oil, coconut oil, and fish oil (from tuna fish; Table 4). The amount of linoleic acid in breast milk varies according to maternal dietary intake, but usually represents about 8% of total fatty acids. Regarding infant formulas, values of

linoleic acid are 8% or more of total fatty acids.<sup>17</sup> Infant formulas use the following polyunsaturated vegetable oils: corn, safflower, and soybean oils, which contain abundant amounts of linolenic acid (usually between 45% and 70% of total fatty acids). All formulas included in our study have their linoleic content levels in the optimal range. All formulas included in our study have included  $\alpha$ -linoleic acid in their formulas and have them in the optimal range (Table 4). It has been found that blood levels of arachidonic acid and docosahexaenoic acid are decreased in infants fed with formulas without these fatty acids compared to infants that are breastfeeding. Long-chain polyunsaturated fatty acids are known to be powerful mediators of metabolism, but it has not been established whether there is a potential of short- or long-term effects on infants.<sup>18</sup> All the formulas included in our study have arachidonic acid and docosahexaenoic acid included and their content levels are as recommended by the ESPGHAN guidelines. Fatty acids in fish oil predominantly include  $\omega$ -3 fatty acids, which are eicosapentaenoic acid (20:5n-3) and docosahexaenoic acid (DHA; 20:6n-3). According to a study by Lucas et al, the data on 300 children from 7.5 to 8 years of age, who had been premature infants, concluded that the fatty acids included in breast milk are associated with higher intelligence quotient. Nonetheless, the subject of whether to add these fatty acids to infant formulas is still in debate.<sup>19-21</sup> NAN has included fish oil from tuna fish in its formula composition. It has been recommended that hydrogenated oils that represent a major source of trans-fatty acids to not be added in infant formula compositions. Although the effects of dietary trans-fatty acids are still not clear,<sup>18</sup> Bebelac has included trans-fatty acids in its formula composition. All other formulas have not added it (Table 4).

### Carbohydrates

Breast milk contains predominantly lactose as a source of carbohydrates. Lactose also plays a role in the process of absorption of calcium and minerals. Many bioactive compounds, such as oligosaccharides, have been found to be attached to lactose in breast milk.<sup>22</sup> Regarding infant formulas, the recommended amount of carbohydrates is between 9g/100kcal and 14g/100kcal of total carbohydrates. Carbohydrates accepted for use in infant formulas include lactose, maltose, sucrose, glucose, maltodextrins, glucose syrup or dried glucose syrup, precooked starch, and gelatinized starch.<sup>18</sup> All the included formulas in our study have their carbohydrate values in the optimal range. The addition of glucose to infant formulas has not been shown to provide any additional benefit and may

adversely increase the osmolarity and the probability of occurrence of the Mallard reaction during the processing of infant formulas.<sup>18</sup> Similac, S-26 GOLD, NAN, and Liptomil have used lactose as the sole carbohydrate source in their formulas. Bebelac also has included lactose but not as a sole source (Table 4). It has been studied that it is acceptable for lactose to be used as a sole source of carbohydrates in infant formulas and that it is safe and appropriate for use in healthy term infants.<sup>18</sup> Regarding Bebelac, it has included 4 additional ingredients in its formula composition, which are glucose, galactose, maltose, and polysaccharides (Table 4).

### Vitamins

Human breast milk contains adequate amounts of most vitamins to support normal infant growth, except for vitamins D and K. Formula-fed infants often have higher serum concentration of vitamin D metabolites than breastfed infants. All formulas included in this study had their vitamins in the optimal range as recommended by the ESPGHAN guidelines.

### Minerals

Table 1 to 3 show that all 5 formulas were fortified with all the essential minerals except for Similac, S26 GOLD, and NAN, which lack fluoride. The proper amount of fluoride from infancy through old age helps prevent and control tooth decay. However, an Expert Panel recommended a minimum level of zero for the fluoride content of infant formulas. It is recognized that fluoride promotes dental health, and there is a question about whether the benefit of fluoride intake during early infancy warrants the risk of dental fluorosis.<sup>23</sup> Bebelac and Liptomil contain an optimal level of fluoride, on the lower extreme. Fluoride was found below the Saudi Arabian Standards Organization recommended range in all the imported bottled-water brands and 2 local brands.<sup>24</sup>

In a study conducted in Iraq, the Similac formula brand has shown different values, which may indicate that there are differences in the ingredients of the same formula brand between Saudi Arabia and Iraq.<sup>25</sup> This leads us to ask, why are there differences between elements in the same brand in each country?

### Limitations

There are more than 18 formula milk brands in Saudi Arabia, and our study was confined to only 5 formula brands. In our study we chose these formulas based on their international popularity and based on which

formulas are considered to be the oldest in the Saudi market. Future studies that include the top-selling formula milk brands in Saudi Arabia are recommended.

## Conclusions

In fact, infants' health is a cornerstone in each health organization. Nutritional status should be studied to save our infants. Fortunately, all brands in this study were safe and nutritionally adequate, but a few ingredients were not found in some brands, which did not affect the total result. The study explains each ingredient separately with comment about the normal amount and the impact of each ingredient to the infants' health. We have to encourage breast milk feeding, and formula should be equivalent to breastfeeding.

## Acknowledgments

The authors gratefully acknowledges Hissah Abdullah Alturki, Ahmed Mohammed Madkhali, and Lojain Ibrahim Alsubaihi.

## Author Contributions

A Almazrooy: Contributed to conception; contributed to acquisition; drafted manuscript; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

A Alturki: Contributed to conception and design; contributed to acquisition, analysis, and interpretation; drafted manuscript; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

A Aljohani: Contributed to design; contributed to acquisition, analysis, and interpretation; drafted manuscript; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

A Alraddadi: Contributed to design; contributed to acquisition, analysis, and interpretation; drafted manuscript; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

A Allogmani: Contributed to design; contributed to acquisition, analysis, and interpretation; drafted manuscript; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

## References

1. Shekar M, Heaver R, Lee YK. *Repositioning Nutrition as Central to Development: A Strategy for Large Scale Action*. 1st ed. Washington, DC: World Bank; 2006.
2. World Health Organization. Infant and young child feeding: model chapter for textbooks for medical students and allied health professionals. [http://www.bing.com/cr?IG=2AB1A3E32D9041BF907E0A6C9231E5F5&CID=39127E02980D624A25857499990B6336&rd=1&h=TD\\_bMzpukcvSiK4v\\_0roZWS3cfVdWb\\_WaAjIvZ2B0BI&v=1&r=http%3a%2f%2fwhqlibdoc.who.int%2fpublications%2f2009%2f9789241597494\\_eng.pdf&p=DevEx,5065.1](http://www.bing.com/cr?IG=2AB1A3E32D9041BF907E0A6C9231E5F5&CID=39127E02980D624A25857499990B6336&rd=1&h=TD_bMzpukcvSiK4v_0roZWS3cfVdWb_WaAjIvZ2B0BI&v=1&r=http%3a%2f%2fwhqlibdoc.who.int%2fpublications%2f2009%2f9789241597494_eng.pdf&p=DevEx,5065.1). Accessed June 8, 2017.
3. Al-Jassir M, Moizuddin SK, Al-Bashir B. A review of some statistics on breastfeeding in Saudi Arabia. *Nutr Health*. 2003;17:123-130.
4. Owens C, Labuschagne I, Lombard M. The basics of prescribing infant formulas. *S Afr Fam Pract*. 2013;54(1):25-30.
5. Motee A, Ramasawmy D, Pugo-Gunsam P, Jeewon R. An assessment of the breastfeeding practices and infant feeding pattern among mothers in Mauritius. *J Nutr Metab*. 2013;2013:243852.
6. Stevens EE, Patrick TE, Pickler R. A history of infant feeding. *J Perinat Educ*. 2009;18(2):32-39.
7. O'Connor NR. Infant formula. *Am Fam Physician*. 2009;79:565-570.
8. International code of marketing breastmilk substitutes. *WHO Chron*. 1981;35:112-117.
9. Koletzko B, Baker S, Cleghorn G, et al. Global standard for the composition of infant formula: recommendations of an ESPGHAN Coordinated International Expert Group. *J Pediatr Gastroenterol Nutr*. 2005;41:584-599.
10. Fomon S. Requirements and recommended dietary intakes of protein during infancy. *Pediatr Res*. 1991;30:391-395.
11. Rigo J, Ziegler EE. *Protein and Energy Requirements in Infancy and Childhood*. Vevey, Switzerland: Nestle Nutrition Institute; 2006.
12. Johnston L. Infant formulas explained. *S Afr Fam Pract*. 2011;53:433-436.
13. Billeaud C, Guillet J, Sandler B. Gastric emptying in infants with or without gastro-oesophageal reflux according to the type of milk. *Eur J Clin Nutr*. 1990;44:577-583.
14. Yogman MW, Zeisel SH, Roberts C. Assessing effects of serotonin precursors on newborn behavior. *J Psychiatr Res*. 1982;17:123-133.
15. Markus CR, Olivier B, Panhuysen GE, et al. The bovine protein  $\alpha$ -lactalbumin increases the plasma ratio of tryptophan to the other large neutral amino acids, and in vulnerable subjects raises brain serotonin activity, reduces cortisol concentration, and improves mood under stress. *Am J Clin Nutr*. 2000;71:1536-1544.
16. Zou X, Huang J, Jin Q, et al. Lipid composition analysis of milk fats from different mammalian species: potential for use as human milk fat substitutes. *J Agric Food Chem*. 2013;61:7070-7080.
17. Carver JD. Advances in nutritional modifications of infant formulas. *Am J Clin Nutr*. 2003;77:1550S-1554S.

- <http://ajcn.nutrition.org/content/77/6/1550S.long>. Accepted May 31, 2017.
18. Raiten DJ, Talbot JM, Waters JH. LSRO report: Assessment of nutrient requirements for infant formulas. *J Nutr*. 1998;128:2059S-2294S.
  19. Koletzko B, Thiel I, Abiodun PO. The fatty acid composition of human milk in Europe and Africa. *J Pediatr*. 1992;120:S62-S70.
  20. Clark KJ, Makrides M, Neumann MA, Gibson RA. Determination of the optimal ratio of linoleic acid to  $\alpha$ -linolenic acid in infant formulas. *J Pediatr*. 1992;120:S151-S158.
  21. Lucas A, Morley R, Cole TJ, Lister G, Leeson-Payne C. Breast milk and subsequent intelligence quotient in children born preterm. *Lancet*. 1992;339:261-264.
  22. Martin CR, Ling PR, Blackburn GL. Review of infant feeding: key features of breast milk and infant formula. *Nutrients*. 2016;8(5):279.
  23. From the Centers for Disease Control and Prevention. Knowledge of the purpose of community water fluoridation—United States, 1990. *JAMA*. 1993;269:29, 32.
  24. Alabdula'aly AI, Khan MA. Chemical composition of bottled water in Saudi Arabia. *Environ Monit Assess*. 1999;54:173-189.
  25. Mikhael EM. Comparison among commonly available infant formula milks in the Iraqi market. *Glob Pediatr Health*. 2015;2:2333794X15608716. doi:10.1177/2333794X15608716.