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Detection of Adulteration and toxic minerals analysis of Infant Milk Powder: an integrated approach to milk quality

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ABSTRACT

Adulterants in milk can cause significant health problems and even deadly illnesses. Because there are no laws or monitoring measures, both developed and developing nations are more in danger. Consequently, 9 elements (Ca, Na, Se, Zn, Fe, Mn, K, Al, and Cd) in a total of seven infant formula samples from seven different brands were identified using inductively coupled plasma atomic emission optical spectroscopy (ICP-OES).

To determine the minerals in the samples. Ca was the major macro element with the highest concentration of 1547.6 mg/kg wet weight in M4, and among trace elements, Zn stands at 3.8 mg/kg wet weight as a higher value in M5. The higher concentration found for Al 3.024 mg/kg wet weight in M5 surpasses the maximum limit set by European regulations. When dried milk was reconstituted, the pH and acidity of all samples were virtually identical to cow milk. pH reached 6.44 - 7.15, acidity from 0.14-0.19. While the higher chloride content recorded in the M4 and M7 were 0.82 ppm. The range of total solids was 11.2-12.4%. Some adulteration tests yielded negative results, indicating that no adulterant ingredients were discovered in the milk samples examined. Founded on the results, it is potential to conclude that there was a significant variation in the quality of milk samples obtained from various locations in Kalar City, regarding the standard of the parameters and the powder, the milk samples were of good quality.

Keywords: Infant formulas, Macro elements, Adulterations, Physicochemical properties, Ion selective, Daily intake.

1. Introduction

In 2008, melamine contamination in Chinese infant milk products raised concerns about milk and dairy product adulteration throughout the world. A swill milk scandal that occurred in 1850 resulted in the deaths of 8000 babies in New York alone (How we poison our children 1858)[1]. The quality and content of milk powder are determined by its physicochemical properties and dairy farmers. Furthermore, several factors like as breeds, fodder intake, feeding system, milking frequency, milking procedure, seasonal variations, lactation time, and adulteration influence the quality and composition[2]. Adulteration is a frequent phenomenon that has gone unnoticed in many places throughout the world. Infant formulae are designed for children aged one to twelve months who, for various reasons, are unable to be nursed by their mother[3].

Milk is one of the most nutrient-dense foods accessible today. It has a high concentration of lipids, proteins, carbs, minerals, organic acids, enzymes, and vitamins. Mineral elements that are crucial to the diet account for around 4 to 6 percent of human body weight[3]. Although breastfeeding satisfies a baby's nutritional demands and promotes growth and development, it is the primary source of nourishment for infants. Micronutrients make up the bulk of milk powder nutrients, including calcium, magnesium, potassium, zinc, and phosphorus[2].

Adequate calcium consumption raises the peak bone mass obtained in early adulthood and, as a result, the retention of skeletal calcium during growth. As a result of cows being exposed to pollution or tainted water, feed, or feeding equipment, dried milk products may be contaminated with a variety of hazardous metals[4]. The most significant source of zinc from dairy products was raw milk[1].

Milk is an essential source of minerals for human health and development, as well as dairy processes like cheese making and other circumstances where proteins and salt interact. Their chemical ingredients are of good quality, with a high proportion of moisture, total solids, fat, total protein, lactose, acidity, and ash. Trace element contaminations in newborn formulae are a hot concern these days, as a high intake of cadmium and lead can lead to cardiovascular illness, nervous system impairment, and bone fractures. High levels of Al in the brain have been linked to

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memory loss and neurodegenerative diseases including Alzheimer's and Parkinson's[5]. Cd and Pb have a long half-life and a propensity to accumulate in many regions of the body[6].

In the whole physiological system, any increase or deficiency of these basic mineral elements, beyond their critical limits, can cause disturbances. Powdered milk is a daily commodity provided by dry milk evaporation that helps to preserve it. Milk is the basic food commodity for babies since children should be breastfed before they are two years of age[7]. However, breastfeeding cannot always be maintained; often women cannot continue or are not able to continue breastfeeding their babies[8]. Then, the safest choice is to have a kid or baby formula The formula is cow's milk subject to special processing which involves changing the proportion between whey and casein protein, replacing animal fat with vegetable fat, reducing the content of sodium, and enriching the milk with micro- and microelements[9].

To the best of the author's knowledge, no detailed study conducted yet on the assessment of trace elements with other mineral components in the infant formula in Iraq. Therefore, this is the preliminary study aimed to investigate the physico-chemical properties (pH, total solid, acidity and ash) and nutritional value or macro elements (Ca, Na, Se, Zn, Fe, Mn, K, Al and Cd) of seven types of powdered milk for children available in the Kalar city markets, Iraq. In addition Milk adulteration detection in infant formulas, in order to evaluate the ions concentration such as (NO_3^-, Cl^- and F^- ppm) of these products, In addition to calculation of maximum estimated daily intake (MDI) of those metals for children.

2. Materials and methods

2.1 Sample collection

Seven types of infants' formula Evolac (M1), Nactalia (m2), Kendamil (M3), Dielac (M4), Mami Lac (M5), Nutri Holland (M6) and BebeLait (M7) were collected from local markets of Iraq (figure 1 and Table 1). Each time for analyzing; specific amount of the milk and milk powder was dissolved in specific volume of water according to the details on container, the milk solution was not stored for another time. After finishing the samples were stored in safe a safe place with the container closed perfectly[10].

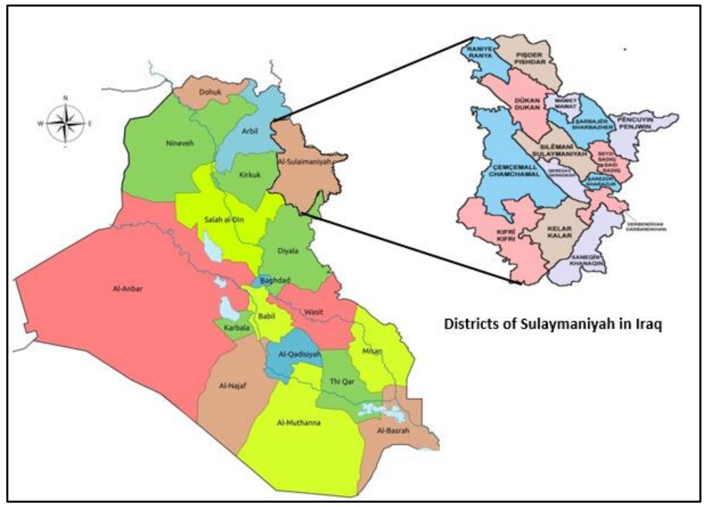

Figure 1: Study area map for the collection of milk powder samples from different markets of northern Iraq.

Table 1: Characteristics of analyzed the powered infant formula samples.

SL No.	Identification	Brand name	Age group	Type of container
1	**M1**	Evolac	**1 – 12 month**	Aluminum tin
2	**M2**	Nactalia	**1 – 12 month**	Aluminum tin
3	**M3**	Kendamil	**1 – 12 month**	Aluminum tin
4	**M4**	Dielac	**1 – 12 month**	Aluminum tin
5	**M5**	Mami Lac	**1 – 12 month**	Aluminum tin
6	**M6**	Nutri Holland	**1 – 12 month**	Aluminum tin
7	**M7**	BebeLait	**1 – 12 month**	Aluminum tin

2.2 Mineral Analysis

Dry ash samples in porcelain crucibles have been solubilized with 6 mL of 6 N HCl and 1 mL of H_2O_2 after that transferred quantitatively. Volume was made to 25 mL using double-deionized water. An ICP-OES (Inductively coupled plasma - optical emission spectrometry) was used to analyze the elements at various wavelengths for each individual mineral[11].

2.3 Physico-chemical analysis

2.3.1 pH

Powder milk was dissolved in distilled water after that pH was measured by pH meter (González-Weller, et al., 2010)[12].

2.3.2 Acidity

About 0.5 g milk sample was taken in 10 mL distilled water into conical flask and add (ph.ph) indicator. The prepared (0.1 N) NaOH in the biuret was used in acid-base titration changing the color of milk to pink indicated the end point[12].

2.3.3 Total solid

The total solids content of the milk samples was evaluated by oven drying them in a laboratory oven at 105 degrees Celsius for 2 hours. All samples were examined in duplicate[13].

$$\text{Total solid content} = \frac{(\text{Weight of dish} + \text{dried samples}) - (\text{Weight of dish} + \text{sample})}{(\text{Weight of dish} + \text{sample}) - (\text{Weight of empty dish})} \times 100$$

2.3.4 Ash %

Ash content was quantitated by dry ashing milk samples in a muffle furnace at 550 ˚C for 5 hours as described in (Al-mentafji, 2016)[14].

$$\text{Ash \%} = \frac{\text{Weight of ignited sample}}{\text{Weight of sample taken}} \times 100$$

2.3.5 Fluoride, chloride and nitrate

The fluoride, chloride, and nitrate tests in milk samples were carried out using the method described by[2], with some modification.

2.4 Estimation daily intake of minerals

Estimated daily intakes (EDIs) of each metal in the assessed brands of milk were determined by multiplying the weight of milk a person consumes by the average concentration of that metal in the milk samples (body weight 9 kg) (Rubio et al., 2015)[8].

$$\text{EDI} = (\text{FIR} \times \text{C}) / \text{BW}$$

Where C is the metal content in powder milk samples (mg/kg), FIR is the food intake rate (g/person/day), and BW is the body weight (kg).

2.5 Adulteration detection methods

The rapid qualitative identification in the milk of various hazardous chemicals is presented in Table 2.

Table 2: Rapid qualitative Chemical tests for detection of adulterants.

Adulterant	Test	Observation	Remarks	Reference
Glucose	In a test tube, add 2 ml of the milk sample and an equivalent amount of the benedict reagent. Place in a boiling water bath for 5 minutes and note changes in color.	Blue color appearance-no glucose present Green-trace amounts Yellow-low concentration Orange-moderate concentration Red-high concentration Red-high concentration	In order to improve consistency and taste, glucose is added to milk.	[37]
Starch	Take a measurement of 3 mL in a test tube. After the Cool it to room temperature by boiling it thoroughly. Add 1 drop of 1% of iodine solution.	The appearance of the blue-black color indicates the starch presence	For milk thickening and to increase the reading of the lactometer.	[23]
Common salt	Put 5 ml of a sample of milk into a test tube. Add 1 ml solution of 0.1 N silver nitrate. Thoroughly mix and incorporate the material 0.5 ml of a solution of 10 percent potassium chromate.	The yellow color appearance suggests the presence of added salts, while the red color of the brick suggests milk free of added salt.	To increase solid-not-fat (SNF) levels, common salts are added to	[37]
Water	Smoothly slant the surface with a small volume of milk	Adulterated milk does not leave a trace and slides more easily.	To increase the quantity and thus minimize consistency, the milk is diluted.	[37]
Benzoic and salicylic acid (hazardous chemicals)	Take a 5 mL sample of milk from the test tube. Drop by drop, 0.5 percent ferric chloride solution is added to it after acidification with sulfuric acid. Just mix it. In a test tube, five ml of milk is ingested And with concentrated sulphuric acid acidified. 0.5% ferric chloride solution is applied drop by drop. Fall and well mixed. Buff Production. The color reveals the presence of benzoic acid and Salicylic acid shows its violet hue.	The appearance of the buff color suggests that benzoic acid is present where Salicylic acid is suggested by the violet color	Function as preservatives and improve the shelf life of the Via the milk	[24]
Nitrate (hazardous chemicals)	Take a beaker with 10 ml of sampled milk. Adding 10 ml solution of mercuric chloride for it. Filter through what guy, after mixing. Take 1 ml of filtrate in the form of add 4 ml of diphenylamine sulphate or diphenyl benzidine reagent to a test tube.	The appearance of the blue color means that nitrates are present. The sample of pure milk will not produce any color.	Act as antibacterial and boost the shelf life of bacteria Via the milk	[20]
Coloring matter	Take a milk sample of 10 mL in the attestation tube. Incorporate 10 ml of diethyl ether. Enable it to stand after shaking.	The presence of additional color is suggested by the appearance of yellow in the ethereal layer.	Incorporated into the milk to improve appearance.	[8]
Detergent	Shake a sample of 5-10ml with equal quantities of water.	Formation of lather confirms presence of detergent	For color improvement in milk and increase SNF	[34]

3. Results and Discussion

3.1 Physicochemical properties in samples

Evolac, Nactalia, Kendamil, Dielac MamiLac, Nutri Holland, and Bebelait milk powder samples had pH values of 6.76, 6.44, 7.0, 6.68, 7.15, 6.77, and 6.6, respectively (Table 3). The pH of various milk powder kinds acquired from the study area did not alter statistically significantly (Table 3). The pH of milk typically ranged from 6.66 to 6.7[15, 16]. According to the current study, the pH of all reconstituted milk samples was within the usual range, with the exception of the Kendamil and MamiLac samples, where the PH was 7.0 and 7.15, respectively, which were somewhat higher than the normal range.

Total solid (TS) percentage of milk powder obtained from Evolac, Nactalia, Kendamil, Dielac, MamiLac, NutriHolland and Bebelait, were 11.4, 12.3, 12.9, 11.7, 11.2, 12.4 and 11.9%, respectively (Table 3). According to the results, there were no appreciable differences in the TS of various types of milk powder purchased from the big store (Table 3). According to the investigation, the average TS of Buffalo whole milk powder from three batches was 96.27, 97.38, and 96.97 g/100 g.[10]. According to the American Dry Milk Institute, the TS content of whole milk powder was 96 percent, and the TS of whole milk powder was 95-98 percent[14].

Table 3: Physicochemical analysis of in found in each analyzed brand.

Parameters	M1	M2	M3	M4	M5	M6	M7
pH	6.76	6.44	7.0	6.68	7.15	6.77	6.6
Total Solid (%)	11.4	12.3	12.9	11.7	11.2	12.4	11.9
Acidity (%)	0.18	0.17	0.19	0.14	0.15	0.16	0.16
Ash (%)	0.71	0.76	0.73	0.79	0.72	0.81	0.74

Acidity of reconstitute milk powder obtained from Evolac, Nactalia, Kendamil, Dielac, Mami Lac, Nutri Holland and Bebelait were 0.18, 0.17, 0.19, 0.14, 0.15, 0.16 and 0.16%, respectively (Table 3). According to Fahmid et al. (2016)[17], The acidity level of dry whole powder milk is suggested as (0.15 %). According to a prior study, the typical acidity of market milk varied from 0.14 to 0.19 percent. The acidity of normal milk samples ranged from 0.10 to 0.18 percent, with an average of 0.16 percent[16, 18].

The ash percentage of milk powder obtained from Evolac, Nactalia, Kendamil, Dielac, MamiLac, NutriHolland and Bebelait were 0.71, 0.76, 0.73, 0.79, 0.72, 0.81 and 0.74, respectively (Table 3). It was observed that the average value of ash obtained from NutriHolland recorded (0.81%) was higher than the milk powder of the present study and the normal range of ash content different according to the source of this powder[19].

Amin (2016)[17] found 0.75% of ash content in buffalo milk which was in line with the current study.

3.2 Adulteration detection in milk samples

The results of the Starch test showed that all samples, which were randomly obtained from dairy stores, were negative for milk powder. According to Table 4 the results shown that the sugars of reconstitute milk powder obtained from seven samples were all negative expect for Nactalia and Bebelait were positive. Also the sample MamiLac was positive common salt, in a very low amount and because our samples were infant formula it is better not to present. In other hand starch test of reconstitute milk powder obtained from seven samples are all negative. Baby formula can either have starch or not have starch. Starch that is used in food is carbohydrate just like sugar[20]. The result of this two tests benzoic and coloring of reconstitute milk powder obtained from the seven samples were all negative. Benzoic and salicylic acid are the most commonly used as preservative in foodstuffs. Because the seven samples that were analyzed were infants' formula should not contain this harmful substance[21].

Table 4: Rapid qualitative detection of different adulterants and hazardous chemicals in each analyzed brand.

Tests	M1	M2	M3	M4	M5	M6	M7
Glucose	(-)ve	(+)ve	(-)ve	(-)ve	(-)ve	(-)ve	(+)ve
Starch	(-)ve	(+)ve	(-)ve	(-)ve	(-)ve	(-)ve	(-)ve
Common salt	(-)ve	(-)ve	(-)ve	(-)ve	(+)ve	(-)ve	(-)ve
Water	(-)ve	(-)ve	(-)ve	(-)ve	(-)ve	(-)ve	(-)ve
Benzoic and	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Nitrate	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Hydrogen	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Coloring	(-)ve	(-)ve	(-)ve	(-)ve	(-)ve	(-)ve	(-)ve
Detergent	N.D	N.D	N.D	N.D	N.D	N.D	N.D

Note: ND: Not detectable

The outcome of the nitrate detection is in rather close agreement with[20]. The successful outcomes were noted by[22]. Nitrate intake from food in excess has a carcinogenic impact, especially on newborn newborns, and causes methemoglobinemia. Our samples are without a doubt devoid of chemical preservatives, However, additional residues, including those from antibiotics or sulfa medications, may be added to milk because of how dairy cows are treated, their food, the milking equipment, and the processing facilities used[6]. Due to the influence of indigestible starch on the colon and the buildup of indigestible starch in diabetic individuals, contaminated milk with high quantities of starch can cause diarrhea[23]. Detergents are added to milk to emulsify and dissolve the oil in the water, producing a frothy solution (foamy appearance), and giving the milk its distinctive white color[16]. The most common adulterants are H_2O_2, formalin, ammonium sulfate, sugar, water, salt, starch, chlorine, hydrated lime, sodium carbonate, and non-milk proteins, among others.,[18].

The fluoride levels determined in powder milk samples collected from the Kalar city in northern Iraq are given in (Table 5). Present study showed that the fluoride concentration of milk powder samples were between (1.2 to 1.5 ppm). The amount of fluoride in powdered milk and the amount of fluoride in infant formula are positively correlated in a small to considerable way. Spectrophotometry, gas chromatography, capillary electrophoresis, micro diffusion, and ion analysis along with ion-selective electrodes can be used to determine the amount of fluoride in water and milk[24].

Nitrate is not hazardous to humans or animals, but it can be transformed to more lethal nitrate during storage and technical procedures. According to the results in Table 5, the mean nitrate concentrations in powder milk months were l (ranged from 0.7 – 0.87 ppm), which was within the allowed limits of 50 (ppm)[8]. As a result, it is obvious that nitrate contamination of dairy cows' water and feed is caused by these compounds. Nitrate and nitrite are often found in human and animal foods. For preservation purposes, such compounds are added to foods such as meat and some types of cheese all over the world. Nitrate levels are quite high in both processed and natural foods[25]. Because nitrates may be converted to nitrite before gestation, in saliva, and in the gastrointestinal tract, the presence of nitrate in food may be considered harmful (Korenekova, et al., 2010)[12, 26]. Chloride channels, which are ubiquitously expressed, facilitate chloride transport across biological membranes[27].

Table 5: Nitrate, chloride and fluoride ion in each analyzed brand.

Parameters	M1	M2	M3	M4	M5	M6	M7
NO_3^- (ppm)	0.85	0.87	0.815	0.86	0.82	0.78	0.79
Cl^- (ppm)	0.81	0.815	0.81	0.82	0.813	0.81	0.82
F^- (ppm)	1.39	1.32	1.5	1.4	1.2	1.23	1.32

3.3 Concentrations of minerals in milk samples

The average concentrations (mg/kg wet weight) of the macro and trace element content for each brand of milk powder under study are shown in Table 6. The values of calcium inside Evolac, Nactalia, Kendamil, Dielac, MamiLac, Nutri Holland and BebeLait were (1350.3, 1523.3, 1330.9, 1547.6, 1510.9, 1448 and 1487.1 mg/kg). Among the seven samples, the Kendamil (M3) had the lowest (1330.9 mg/kg wet weight) and Dielac showed the highest value 1547.6 mg/kg. The specific limit concentration of Ca in infant formula is set to 220 -300.0 ppm in the European Community Regulation 466/2001, the maximum limit in the Saudi specification (1904/2001 Milk is also high in calcium, phosphate, and fat-soluble vitamins (A, D, E, and K). As a result, it is nature's most nearly perfect meal[28]. Although some studies have found that calcium, due to its comparable chemical properties, interferes with lead absorption in the gastrointestinal tract[29]. The iron levels in Dielac (M4) were the highest (5.1 mg/kg wet weight) among the seven samples, with sample (M6) having the lowest iron levels (2.3 mg/kg wet weight). Iron deficiency in children can lead to anemia, a disease in which the body does not have enough healthy red blood cells[30]. Excess sodium may have acute health consequences for the newborn infant, as well as long-term health consequences.

Among the seven samples, the ratio of Nactalia (M2) was the highest (1030.1 mg/kg wet weight), whereas Evolac (M1) was the lowest (632.7 mg/kg wet weight).

Table 6 shows that the proposed food has less sodium and more potassium than the recommended daily consumption for children aged 1–12 months. Salt enhances the flavor of food, and the flavor of food is assessed by the child's meal provider. Many countries are concerned about salt consumption, hence sodium chloride has been substituted by potassium chloride. This aspect of the data provided in (Table 6) should be looked in[26], to further[30]. In terms of hazardous metals, M7 has the highest level of Al at 3.7 mg/kg wet weight. Furthermore, the Mn content in M1 is notable, with a mean value of 0.94 mg/kg wet weight. In the Table 6 noted the level Zn in sample M5 was higher than other samples while M6 was recorded the lowest Zn content (2.4 mg/kg wet weight) High Zn level in body causes (nausea diarrhea hatches), while low Zn level in the body causes (hair loss and weight loss)[9]. The values of selenium in sample M2 was higher than other sample was (mg/kg wet weight). The United Nations Health Organization defined selenium to be a trace element that humans require[31]. Although selenium level in human tissue is minimal, it is essential for iron, zinc, iodine, and other trace elements[32].

About 75 grams of milk powder should be consumed daily according to the manufacturers whose products were under investigation[31, 33]. Utilizing the recommended consumption and the average concentrations discovered for each element, the estimated daily intake (EDI) was determined (Table 7). Using the recommended intake and the average concentrations for each element found, the estimated daily intake (EDI) was determined (Table 7). The Recommended Daily Intake (RDA) values for crucial macronutrients and trace elements for babies and toddlers are provided by the Spanish Federation of Nutrition, Food, and Dietetic Societies (Table 8), as follows: 515 mg Ca/day, 720 mg K/day, 85 mg/day, 390 mg Na/day, 9 mg Fe/ day, 7 mg Zn/day, 0.5 µg Cu/day, 0.8 mg Mn/day, 4 µg Mo/day[34]. The fact that the present research EDI values were within the RDI but below the Tolerable Upper Level (TUL) suggested that the milk under examination posed no major danger to children[35, 36].

Table 6: Macro element and trace element content (mg/kg wet weight) found in each analyzed brand, compared with world health organization [38].

Elements	M1	M2	M3	M4	M5	M6	M7	WHO (1985)
Ca	1350.3	1523.3	1330.9	1547.6	1510.9	1448.0	1487.3	220.0 – 300.0 mg/100 ml
Na	632.7	1030.1	743.9	549.8	672.1	759.6	650.9	90.00 – 130.00 mg/100 ml
Se	0.4	1.2	0.5	0.9	0.8	1.3	1.1	90.00 – 130.00 µg/100 ml
Zn	3.2	2.6	3.1	3.5	3.8	2.4	1.6	0.70 – 2.00 mg/100 ml
Fe	3.5	3.6	4.3	5.1	3.2	2.3	3.7	0.35 – 0.72 mg/100 ml
Mn	0.94	0.87	0.8	1.25	0.92	1.01	1.4	3.00 – 4.00 mg/100 ml
K	920.4	1008.3	879.9	971.5	758.4	790.7	830.2	410.0 – 550.0 mg/100 ml
Al	2.05	2.3	1.05	3.6	3.024	2.9	3.7	0.5 µg/g – 5.9 µg/100 ml
Cd	N.D	N.D	N.D	N.D	N.D	N.D	N.D	-------

Table 7: Estimation daily intake (EDI) of Macro element and trace element in each analyzed brand.

Minerals	M1	M2	M3	M4	M5	M6	M7
Ca	3751	4231.4	3711.9	4299	4196.9	4022.2	4131.4
Na	5273	8584.1	6199.1	4582	5600.8	6330	5424.2
Se	3.333	10.0	4.10	7.50	6.67	10.8	9.16
Zn	26.67	21.67	25.8	29.17	31.67	20	13.34
Fe	29.17	30	35.833	42.5	26.6	19.16	30.83
Mn	0.0332	0.0307	0.0282	0.0442	0.00325	0.00356	0.0494
Al	10.25	11.5	5.25	18	15.12	14.5	18.5

Table 8: Macro element and trace element concentration in human milk as referred in the literature.

Elements	Unite	RDI (0-6 months)	RDI (7-12 months)	Tolerable upper level (TUI)[a]	RDI allowance[39]
Ca	mg/kg	864	526	2500	1000-1250
Na	mg/kg	285	345	2300	1275-1470
Se	µg/day	15	17	45	10-40
Zn	mg/day	5	7	14	2-10
Fe	mg/kg	14	114	50	44-411
Mn	mg/day	2	2	4.12	3.3-3.9
K	m/kg	810	790	3700	2000-2200
Al	mg/kg	0.224	0.318	7	0.55- 6

Conclusion

ICP-OES was used to assess the concentration of macro elements and trace metals (Ca, Na, Se, Zn, Fe, Zn, Mn, K, Al, and Cd) in seven samples of seven different brands of newborn milk formula. According to the findings of the study, baby formulae satisfy the nutritional demands of babies aged 1 to 12 months in terms of macro elements and essential elements. The electrical conductivity approach was also capable of detecting Nitrate, chloride, and fluoride adulteration. This result showed that all milk powder brands under study complied with the legal requirements for milk content in the powder. This result implied that every milk powder under investigation met the legal requirements for milk content in powder.

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Conflict of interests

None

Author contribution

The author of this study all stages of the writing, reviewing, and submission of this study

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