Journal of Chemical Health Risks

www.jchr.org

ORIGINAL ARTICLE

Estimation of Daily Intake and Mineral Content of Ice Cream in Bangladesh

Palash Kumar Dhar*[1], Muhammad Sarwar Hossain[1,2], Md. Nazim Uddin[3]

[1]*Chemistry Discipline, Khulna University, Khulna-9208, Bangladesh*
[2]*Department of Chemistry, Sogang University, Seoul 04107, Republic of Korea*
[3]*Department of Chemistry, Khulna University of Engineering and Technology, Khulna, Bangladesh*

(Received: 14 July 2020 Accepted: 16 December 2020)

KEYWORDS

Ice cream;
Minerals;
ICP-OES;
Estimated daily intake;
Bangladesh

ABSTRACT: Milk and dairy products are avowed as rich source of dietary minerals. Globally, the popularity of ice cream is increasing due to its nutritional benefits and appealing tastes. Therefore, the main objectives of this study were: (a) to determine the concentration of macro-elements (K, Na, Mg, Ca, and P) in commercially available ice cream in Bangladesh; (b) to point out their contribution to our daily diet formulation. Based on the popularity, and availability, seven leading brands were selected and five samples from each brand were randomly purchased irrespective of their types, flavour, taste, and price. The concentration of macro-minerals were quantified using Inductively Coupled Optical Emission Spectrophotometer (ICP-OES) and UV-Vis Spectrophotometer. The average concentration (fresh weight) of studied elements had shown a descending order of Ca (1529.41±278.88) > K (1363.69±198.68) > P (1187.76±231.23) > Na (569.79±141.14) > Mg (194.90±68.59) mg kg^{-1}. Pearson's correlation matrix among the different metals revealed a significant correlation between K-Na ($r = 0.418$) and K-Mg ($r = 0.408$) at $p < 0.05$ levels. The average estimated daily intake (EDI) of K, Na, Mg, Ca, and P were found 40.97, 17.12, 5.85, 45.94, and 35.68 mg day^{-1}, respectively, which indicated none of the studied samples exceeded the recommended daily allowance (RDA). The consumption of ice cream (30.04 g day^{-1}) showed 0.87-7.34% contributions of macro-elements to our daily diet. The present study concludes that ice cream could be considered as a possible source of essential minerals (especially Ca, and P). However, to assure the food quality and to create a balanced diet, regular monitoring of milk and dairy products is strongly recommended.

INTRODUCTION

Milk and dairy products are good sources of vitamins, proteins, dietary minerals and essential components of a balanced diet [1–3]. Ice cream is one of the most popular frozen dairy products, which is consumed by all age groups especially children during the summer season [4]. Globally, the popularity of ice cream is increasing due to its potential nutritional benefits and appealing taste. Studies showed that the major consumer countries are New Zealand, the United States, Australia, Canada, Belgium, Finland, and Sweden [5]. In 2013, New Zealand took the top spot of ice cream consumers with 28.4 L.capita^{-1} per year. While the United States was at second position with 20.8 L.capita^{-1} of ice cream per annum. Australia came in third place of ice cream eating with 18 L.capita^{-1} [6]. In Bangladesh, the ice cream industry contributes around BDT 6.5 billion, among them 85% constitutes is the branded ice cream producer and the remaining is the artisanal maker [7].

Generally, ice cream is made by suitable blending and processing of cream or other milk products, together with

---

*Corresponding author: palashdhar@ku.ac.bd (P. Kumar Dhar)

DOI: 10.22034/jchr.2020.1904397.1156

sugar, eggs, nuts, chocolates, cocoa, fruits, flavor, additives, etc. [5, 8]. Furthermore, a very small amount (0.5% by weight) of emulsifiers and stabilizers may be added during the processing of ice cream [8]. To get the desired appearance, texture, consistency, and taste of the final product various kinds of raw materials are used [5].

Some minerals especially Ca, Mg, Na, K, and P play pivotal roles in metabolic processes, maintaining blood sugar levels, and enhancing weight gain [9]. Besides, Ca and P are necessary for bone growth and proper development of newborns [10, 11]. In the human body, mineral components account for four percent of total body mass. Several studies reported that these minerals have biochemical, structural, and nutritional functions, which are very important for both mental and physical health. Moreover, they act as catalysts that accelerate numerous biological reactions in the body, for instance, the transmission of nerve impulses, muscle contraction, and the utilization of nutrients from food [12, 13].

On the other hand, extreme ingestion of these elements may arise several health implications like kidney dysfunction, high blood pressure, stroke, hypertension, and cardiovascular disease [14, 15]. To date, there are limited data available regarding the mineral profiles of ice cream and the people of Bangladesh consume ice cream without knowing their nutritional benefits. To assure the food quality and to evaluate the nutritional value of ice cream, this research was carried out. Therefore, the prime objectives of this research were to determine the concentration of major minerals (Ca, Mg, Na, K, and P) in commercially available ice cream in the Bangladeshi market and to point out their contribution to our daily diet.

MATERIALS AND METHODS

Sample collection, preparation, and analysis

In the Khulna city of Bangladesh, several ice cream manufacturers supply different types of ice cream (cup, cone, chalk bar, lolly, etc.). Based on the popularity, and availability seven leading ice cream brands were selected. For homogenous sampling, an equal number of ice cream samples (n=5 from each brand) were randomly collected from the local markets irrespective of their types, flavour, taste, and price, during 2019. To keep the brand’s identity anonymous the samples were labeled from A to G. The collected samples were transported using an icebox and transferred into a refrigerator at −20 °C. On the day of sample preparation, the plain ice cream samples were softened at room temperature and mixed thoroughly by stirring with a spoon [16]. In the case of ice cream, where the chocolate or similar covering portion forms a separate layer, that part was removed and the remaining portion was taken for analysis. For fruit and nut containing ice cream, the samples were homogenized with a commercial blender to get uniform and fine particles [16].

Approximately, 1.0~2.0 g of the ice cream sample was digested with a freshly prepared di-acid mixture HNO_3: H_2O_2 at 6:1 ratio (Merck, Darmstadt, Germany) on a hot plate at 90°C until a transparent solution was obtained [17]. After digestion, the samples were diluted up to 25 mL with a sufficient amount of deionized water and the diluted solution was filtered through filter paper (Whatmann 42) to avoid solid impurities. ICP-OES (SPRECTRO GENESIS, Kleve, Germany) was used to determine the concentration of Na, K, Mg, and Ca. The operating and working conditions of ICP−OES were as follows: Plasma Power 1400W; Pump speed 30 rpm; Auxiliary flow 0.80 L min^{-1}; Coolant flow 13 L min^{-1}; Nebulizer flow 0.80 L min^{-1}; Nebulizer pressure 3.12 bar (2.0−4.0), Main argon pressure 7.3 bar (6.0−8.0), Plasma torch Quartz, fixed 1.8 mm injector tube; Career gas Argon; Replicates 3 times; Sample uptake delay 45 sec; Sample uptake rate 1 mL min^{-1}, Rinse time 10 sec; Wavelengths K (766.490), Na (588.995), Mg (285.213), and Ca (315.887) nm. The concentration of phosphorus (P) in ice cream samples was quantified colorimetrically according to the chlorostannous - reduced molybdophosphoric blue color method [10, 18]. Briefly, 1.0 g homogenized ice cream sample and 4 mL sulphomolybdic acid was taken in a 50 mL volumetric flask followed by the addition of 4-6 drops of stannous chloride ($SnCl_2.2H_2O$) solution (Loba Chemie, India). The color intensity was measured at 660 nm using a UV-Visible Spectrophotometer (UVD-3200, LABOMED INC. USA) within 10 to 15 minutes after the addition of $SnCl_2.2H_2O$ solution.

Estimated daily intakes (EDI)

The EDI values (mg day^{-1}) of studied minerals through the consumption of the ice cream were calculated by the following equation [19]:

$$EDI= C \times ADI \times 10^{-3}$$

Where, C is the mean concentration of an element on a fresh weight basis (mg kg^{-1}), and ADI is the average daily intake, which was considered as 30.04 g day^{-1} (fresh weight) for milk products from the reported data of household income and expenditure survey 2016 [20].

Contribution to recommended dietary allowance (%RDA)

To assess the contribution of dietary elements through ice cream consumption, the RDA for children, men, and women were drawn from the report of the Institute of Medicine (US) Panel on Micronutrients [21]. The percentage of contribution to RDA was calculated as follows [19]:

$$\%RDA=\frac{EDI}{RDA}$$

Statistical analysis

Pearson's correlation was evaluated using SPSS software (version 26) to establish the strength of the interaction between the analyzed dietary minerals of ice creams. The level of significance was considered as $p < 0.05$.

RESULTS AND DISCUSSION

In this study, the concentrations of essential elements for all ice cream samples were estimated on a fresh weight basis and are shown in Table 1. The mean values of studied elements in thirty-five samples were found K (1363.69±198.68), Na (569.79±141.14), Mg (194.90±68.59), Ca (1529.41±278.88) and P (1187.76±231.23) mg.kg^{-1}. In addition, the range of K, Na, Mg, Ca, and P in all studied samples were (940.35-1751.32), (248.19-887.81), (88.67-371.87), (1016.39-2147.62) and (748.93-1786.90) mg kg^{-1}, respectively. The decreasing trends of the concentration of K, Na, Ca, Mg and P among the different brands were A > B > F > C > D > G > E, A > D > B > C > G > F > E, D > E > B > C > A > G > F, F > A > C > E > D > B > G and E > D > B > C > A > F > G, respectively.

Table 1. Concentrations of nutrients (mg.kg^{-1} fresh weight) in ice cream samples collected from the local markets of Khulna, Bangladesh

Brands	K	Na	Mg	Ca	P
A	1528.22	702.32	186.66	1658.78	1137.16
	1363.37-1676.91	567.95-826.73	103.53-284.79	1484.32-1861.59	979.36-1237.39
B	1457.92	618.09	202.52	1404.47	1207.85
	940.35-1751.32	384.19-727.37	98.43-371.87	1039.59-1618.77	1089.32-1362.74
C	1371.97	568.35	191.51	1575.14	1196.61
	1227.68-1539.85	412.83-701.42	121.39-275.25	1147.79-2043.47	905.49-1679.23
D	1343.19	673.25	226.41	1478.75	1335.94
	1089.47-1573.23	477.89-887.81	88.67-316.33	1223.95-1741.38	1006.16-1786.90
E	1172.56	453.80	215.43	1514.82	1383.11
	1021.13-1339.42	329.62-598.26	144.59-286.48	1045.74-1816.64	1107.49-1597.44
F	1415.36	495.93	164.03	1677.26	1066.34
	1299.47-1654.87	248.19-637.90	122.53-269.36	1116.46-2147.62	849.68-1293.46
G	1258.12	523.59	177.90	1396.67	987.31
	1108.73-1497.89	436.63-614.16	129.36-237.45	1016.39-1857.72	748.93-1197.85
Mean	**1363.96±198.68**	**569.79±141.14**	**194.90±68.59**	**1529.41±278.88**	**1187.76±231.23**
Range	**940.35-1751.32**	**248.19-887.81**	**88.67-371.87**	**1016.39-2147.62**	**748.93-1786.90**

Sodium (Na) is considered the principal cation of extracellular fluids, which plays an essential role in nerve transmission, muscle contraction, and cellular homeostasis. Besides, Na regulates the enzyme activity, modulates the distribution of body water, blood pressure, and electrolytic balance [8, 21]. An adult body (70 kg) contains a total of 100 g of Na. Based on physiological conditions; an adult needs to consume 4–5 g day^{-1} of Na [9, 21]. A higher amount of Na intake is responsible for hypertension, high blood pressure, stroke, and cardiovascular disease [23]. On the other hand, deficiency of Na may cause excess sweating, diarrhea, kidney dysfunction, and renal failure [23]. The ICP–OES determination of Na was ranged between 248.19 (in brand F) and 887.81 (in brand D) mg kg^{-1}. The mean concentration (569.79±141.14 mg kg^{-1}) was similar to the reported value of Na in ice cream samples 537.38±6.37 mg kg^{-1} [22], 581.30±37.92 mg kg^{-1} [10]. Whereas it was lower than the reported value of 690 mg kg^{-1} [13] (Table 2) and RDA (1200 mg day^{-1} for children and 1500 mg day^{-1} for adults) [21].

Table 2. Comparison of mean concentration (mg kg^{-1}) of studied elements in all ice cream samples with similar studies

K	Na	Mg	Ca	P	Ref.
1280.56±14.30	581.30± 37.92	267.35±42.09	1803.6±200.40	1673.99±59.17	[10]
1600	690	130	1300	1100	[13]
1669.56±21.2	537.68±6.37	159.31±1.39	1844.36±12.72	1100.86±0.01	[22]
1363.96±198.68	**569.79±141.14**	**194.90±68.59**	**1529.41±278.88**	**1187.76±231.23**	**Present study**

Unlike Sodium, Potassium (K) is mainly intracellular and the amount of K in an adult body is 140–170 g [9]. The majority of K is found in the cells of the liver, kidneys, bone, muscle tissue, and red blood cell. K involves in several biological functions like neurotransmission, regulation of blood pressure, muscle contraction, and activation of enzymes [9]. Depending on the physiological state, the requirement of K for an adult varies 3–6 g day^{-1}. A normal diet provides 2–6 g day^{-1} of K and dairy products are excellent sources of this element [9]. However, a low concentration of K in the blood may arise symptoms like weakness, mental stress, and, if extreme, heart failure may result. Subsequently, an excessive level of K may be harmful if the kidneys are not functioning properly [23]. In this study, the concentration of K in ice cream samples was analyzed and the range was found between 940.35 (in brand B) and 1751.32 (in brand B) mg kg^{-1}. The average concentration of K (1363.96±198.68 mg kg^{-1}) was much lower than the reported value of 1669.56±21.2 mg kg^{-1} [22], 1600 mg kg^{-1} [13] (Table 2) and RDA (3800 and 4700 mg day^{-1} for children and adults) [21]. Contrarily, the mean concentration was higher than the previously published value of K (1280.56±14.30 mg kg^{-1}) [10].

In the human body, Calcium (Ca) is the most abundant mineral and important for teeth and bone health [9]. Furthermore, it contributes to blood clotting, cell signaling, blood pressure, fertility, cell proliferation, muscle contraction, hormone secretion, heartbeats, and nervous system function [9, 24]. The major portion of the Ca (about 99%) is found in the bone tissues of human organisms. A significant deficiency of Ca increases the susceptibility to bone fracture, which results in osteoporosis [9]. Without consuming milk and dairy products it is difficult to prevent these deficiencies. Based on the obtained results, the concentration of Ca was ranged between 1016.39 and 2147.62 mg kg^{-1}, and the mean concentration (1529.41±278.88 mg.kg^{-1}) was lower than the reported value of 1844.36±12.72 mg kg^{-1} [22] and 1803.6±200.4 mg kg^{-1} [10]. On the other hand, the previously reported value of Ca (1300 mg kg^{-1}) [13] was comparatively lower than the mean concentration of the present study (Table 2). However, none of the studied samples exceeded the RDA of Ca (1000 mg day^{-1} for children, men, and women) [21].

Magnesium (Mg) is the fourth most abundant element in the body after Na, K, and Ca and the second most important intracellular cation. Generally, the body of a 70 kg adult contains 15–20 g of Mg, which is required for the proper growth and development of bones [11]. Also, Mg is important to maintain heart rhythm, preserve nerve function, muscle contraction, promote the immune system, hormone secretion, and protein formation, regulate blood pressure, regulate blood sugar, and be involved in energy production [24, 25]. Therefore, Mg is taken as dietary supplements to prevent Mg deficiency and dairy products can be considered as a potential source of Mg. Deficiency is rare but an extreme scarcity of Mg may cause neuromuscular dysfunction, muscle weakness, and mild hypomagnesemia [23]. Contrarily, regular intake of high dose supplements can result in diarrhea [25]. In this study, the lowest and highest concentration of Mg was observed at 88.67 (in brand D) and 371.87 mg kg^{-1} (in brand B). The mean concentration (194.90±68.59 mg kg^{-1}) was slightly higher than the reported value of 159.38±1.39 mg kg^{-1} [22] and 130 mg kg^{-1} [13]. On the other hand, this value was comparatively lower than the previously published value of 267.35±42.09 mg kg^{-1} [10] (Table 2) and the RDA of Mg (130, 400, and 310 mg.day^{-1} for children, men, and women, respectively) [21].

Phosphorus (P) is another major element, which triggers many vital biological functions in the human body. It occurs both as inorganic and organic phosphate in body fluids and tissues and is the prime component of many biological compounds such as carbohydrates, lipids, nucleic acids, and proteins [13, 14]. As calcium phosphate, P is the most important structural element of bones and teeth. However, excessive or extreme intake of this mineral may reduce the Ca level and pose negative effects on bones [13, 26]. In this research, the minimum and maximum P content was observed 948.93 (in brand G) and 1786.90 (in brand D) mg kg^{-1}. The mean concentration of P (1187.76±231.23 mg kg^{-1}) was almost similar to the reported value of 1100 mg kg^{-1} [13] and 1100.86±0.01 mg kg^{-1} [22]. Contrariwise, the average concentration of P was much lower than the reported value of P (1673.99±59.17 mg kg^{-1}) [10] (Table 2). However, the estimated daily intake of P through the consumption of ice cream was calculated at 35.68 mg day^{-1}, which was much lower than the RDA of P (500 and 700 mg.day^{-1} for children and adults) [21].

Correlation matrix analysis

To identify the common sources of elements, Pearson's correlation matrices among the K, Na, Mg, Ca, and P in ice cream samples were analyzed (Table 3). This study revealed that Na had a significantly (at 0.05 level) positive correlation with K and Mg, suggesting a common source of elements. On the other hand, no significant positive correlation was found among the K−Mg, K−Ca, K−P, Na−Ca, Na−P, Mg−Ca, Mg−P, and Ca−P, therefore, the abundant sources are different for these elements.

Table 3. Correlation coefficient matrix of essential elements in ice cream collected from Khulna, Bangladesh.

Elements	K	Na	Mg	Ca	P
K	1.00				
Na	.418*	1			
Mg	.408*	0.272	1		
Ca	0.317	0.166	0.277	1	
P	-0.079	-0.09	0.176	0.12	1

* Correlation is significant at the 0.05 level (2-tailed).

Dietary intakes of minerals

RDA can be defined as the amount of element, which needs to consume on daily basis to maintain a normal physiological state. The deficiency of these elements can be fulfilled by the consumption of different types of nutrient-rich foods in the diet [19]. The mean EDI of essential minerals due to consumption of ice cream and their (%) contribution to RDA for children (4−8 years), men, and women (19−30 years) are shown in Table 4. In this study, the average EDI of K, Na, Mg, Ca, and P were found 40.97, 17.12, 5.85, 45.94, and 35.68 mg day^{-1}, respectively, which were insufficient with compared to RDA for both children and adults (Table 4).

Table 4. Mean EDI (mg day^{-1}) values and contribution (%) to RDA values of dietary minerals for children (4-8 years), men, and women (19-30 years) [21] through the daily intake of 30.04 g ice cream

Elements	EDI	Children		Men		Women	
		RDA	%RDA	RDA	%RDA	RDA	%RDA
K	40.97	3800	1.08	4700	0.87	4700	0.87
Na	17.12	1200	1.43	1500	1.14	1500	1.14
Mg	5.85	130	4.50	400	1.46	310	1.89
Ca	45.94	1000	4.59	1000	4.59	1000	4.59
P	35.68	500	7.34	700	5.24	700	5.24

The average percentage of contributions (%RDA) of K, Na, Mg, Ca and P ranged from 0.87−1.08, 1.14−1.43, 1.89−4.50, 4.59, and 5.24−7.34%, respectively among the studied ice cream samples. From the nutritional point of view, K has a low percentage of contribution to RDA, whereas P contributes the highest percentage to RDA. However, a diet enriched in Na with a high Na/K ratio causes health implications [19]. In this study, the mean concentration of Na was significantly lower in comparison to K in the examined ice cream samples and the Na/K ratio varied between 0.35 and 0.5, which was apprised to be favorable. The EDI and %RDA analyses revealed that the consumption of ice cream (30.04 $g.day^{-1}$) could have a significant contribution to our daily diet.

CONCLUSIONS

The present study highlights valuable information regarding the concentrations of macro-minerals present in ice cream samples. Besides, this study points out their contribution to our daily diet. The decreasing sequence of the average concentration of minerals among all brands was Ca > K > P > Na > Mg. Pearson's correlation matrix among the different metals revealed a significant correlation between K–Na and K–Mg at $p < 0.05$ levels. The EDI and %RDA analyses revealed that Ca, and P have a significant contribution and ice cream could be a possible source of nutritional supplement to our daily diet.

ACKNOWLEDGMENTS

The authors are grateful to Research Cell, Khulna University, Bangladesh for providing the financial support (Grant ID No. KURC-RGP-17/20/8).

Conflict of interest

The authors declare that they have no competing interests.

REFERENCES

1. Kazeminia M., Mahmoudi R., Ghajarbeygi P., Mousavi S., 2019. The effect of seasonal variation on the chemical and microbial quality of raw milk samples used in Qazvin, Iran. J Chem Health Risks. 9(2), 157–165.
2. Farhoodi A., Mahmoudi R., Ghajarbeygi P., Fakhri O., 2016. Physicochemical and bacterial properties of pasteurized milk samples collected from Tabriz, Northwestern Iran. J Chem Health Risks. 6(2), 85–90.
3. Sadeghi N., Behzad M., Razavi S.H., Jannat B., Oveisi M.R., Hajimahmoodi M., 2020. Measurement of zinc, copper, lead, and cadmium in the variety of packaging milk and raw milk in Tehran markets by anodic stripping voltammetry. J Chem Health Risks. 10(3), 175–183.
4. El-Sharef N., Ghenghesh K.S., Abognah Y.S., Gnan S.O., Rahouma A., 2006. Bacteriological quality of ice cream in Tripoli-Libya. Food Control. 17(8), 637–641.
5. Conficoni D., Alberghini L., Bissacco E., Ferioli M., Giaccone V., 2017. Heavy metal presence in two different types of ice cream: artisanal ice cream (Italian Gelato) and industrial ice cream. J Food Protec. 80(3), 443–446.
6. Frozen Dessert Supplies. Which Countries Eat the Most Ice Cream? Ice Cream Consumption by Countries. https://frozendessertsupplies.com/blogs/news/which-countries-eat-the-most-ice-cream-ice-cream-consumption-by-countries (Accessed April 25, 2020).
7. Fahad M., Ice Cream Industry in Bangladesh. Assignment, BRAC University: Bangladesh, July 2014. Available from: https://idoc.pub/documents/ice-cream-industry-in-bangladesh-x4e6krow6gn3

8. De S. Outlines of Dairy Technology, 1st ed., Oxford University Press: India, 2005.

9. Gaucheron F., 2013. Milk Minerals, Trace Elements, and Macroelements. In: Milk and Dairy Products in Human Nutrition Production Composition and Health, 1st ed., Park, Y.W., Haenlein, G.F.W., Eds., Wiley-Blackwell: Hoboken, NJ. pp. 172–199.

10. Kibria S., Masum A.K.M., Islam M.A., Harun-ur-Rashid M., 2017. Mineral profiles of powder milk, yoghurt, ice-cream and raw milk. Asian J Med Biol Res. 3(2), 294–297.

11. Askary N., Bolandi M., 2013. Assessment of iron fortification influence on organoleptics and physico-chemical properties of yogurt. J Chem Health Risks. 3(2), 1–8.

12. Vahc□ić N., Hruškar M., Marković K., Banović M., Barić I.C., 2010. Essential minerals in milk and their daily intake through milk consumption. Mljekarstvo. 60(2), 77–85.

13. Zamberlin Š., Antunac N., Havranek J., Samaržija D., 2012. Mineral elements in milk and dairy products. Mljekarstvo. 62(2), 111–125.

14. Cashman K.D., 2011. Milk Salts (Macroelements, Nutritional Significance). In: Encyclopedia of Dairy Sciences, 2nd ed., Fuquay, J.W., Fox, P.F., McSweeney, P.L.H., Eds. Academic Press: London. pp. 925–932.

15. Ayar A., Sert D., Akin N., 2009. The trace metal levels in milk and dairy products consumed in middle Anatolia-Turkey. Environ Monit Assess. 152, 1–12.

16. Food Safety and Standards Authority of India (FSSAI). Manual of Methods of Analysis of Foods: Milk and Milk Products. Ministry of Health and Family Welfare Government of India: New Delhi, 2015. Available from: https://old.fssai.gov.in/Portals/0/Pdf/Draft_Manuals/MILK_AND_MILK_PRODUCTS.pdf

17. Muhib M.I., Chowdhury M.A.Z., Easha N.J., Rahman M.M., Shammi M., Fardous Z., Bari M.L., Uddin M.K., Kurasaki M., Alam M.K., 2016. Investigation of heavy metal contents in cow milk samples from area of Dhaka, Bangladesh. Int J Food Contam. 3(16), 1–10.

18. American Public Health Association (APHA). Standard Methods for the Examination of Water and Wastewater, 23rd ed., American Public Health Association, American Water Works Association, Water Environment Federation: Washington DC, 2017.

19. Singh R., Kaur N., Shri R., Singh A.P., Dhingra G.S., 2020. Proximate composition and element contents of selected species of *Ganoderma* with reference to dietary intakes. Environ Monit Assess. 192, 1–15.

20. Bangladesh Bureau of Statistics (BBS). Final Report on Household Income and Expenditure Survey 2016. Statistics and Information Division: Bangladesh, 2019. Available from: https://bbs.portal.gov.bd/site/page/b588b454-0f88-4679-bf20-90e06dc1d10b/-

21. Yangilar F., 2015. Mineral contents and physical, chemical, sensory properties of ice cream enriched with date fibre. Italian J Food Sci. 27(3), 397–406.

22. Institute of Medicine (US) Panel on Micronutrients. Dietary reference intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc. National Academy Press (US): Washington DC, 2001. Available from: https://www.ncbi.nlm.nih.gov/books/NBK222310/

23. British Nutrition Foundation (BNF). Minerals and Trace Elements. https://www.nutrition.org.uk/nutritionscience/nutrients-food-and-ingredients/minerals-and-trace-elements.html (Accessed May 23, 2020).

24. Marrero J., Rebagliati R.J., Leiva E., Londonio A., Smichowski P., 2013. Inductively coupled plasma optical emission spectrometric determination of fifteen elements in dietary supplements: are the concentrations declared in the labels accurate? Microchem J. 108, 81–86.

25. Elgammal S.M., Khorshed M.A., Ismail E.H., 2019. Determination of heavy metal content in whey protein samples from markets in Giza, Egypt, using inductively coupled plasma optical emission spectrometry and graphite furnace atomic absorption spectrometry: a probabilistic risk assessment study. J Food Compos Anal. 84, 103300.

26. Cashman K.D., 2006. Milk minerals (including trace elements) and bone health. Int Dairy J. 16(11), 1389–1398.