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Research Article

Daily Intake of Buffalo's Milk and its Contribution in the RDA Values of Some Essential Minerals Required for 1-12 Years Children - @

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ABSTRACT

In this study seven essential minerals copper, zinc, calcium, magnesium, phosphorus, sodium and potassium were measured in buffalo's milk collected from the urban area of District Jamshoro in order to determine their Daily Intake (DI) and Recommended Daily Allowance (RDA) values for 1-12 years children. All the milk samples were prepared for mineral analysis as per reported methods and their concentrations were obtained by using Atomic Absorption Spectroscopy (AAS). Mean concentrations of essential minerals in buffaloes milk were found in the order of $K > Ca > P > Na > Mg > Zn > Cu$. All the analysed minerals were in range with literature data. Based on the milk consumption data highest daily intake of minerals were determined for 1-3 years children followed by 4-8 and 9-12 years. Daily intake of minerals was found in the order of $K > Ca > P > Na > Mg > Zn > Cu$ in children. Daily intake values of these minerals in children were below the respective ranges recommended by Institute of Medicine (IOM). In RDA contribution it was observed that milk had good contribution for Ca followed by P, Cu, Mg, Zn, K and Na for all age group children.

Keywords: Milk; Essential minerals; Daily intake; Urban area; Jamshoro

INTRODUCTION

Daily intake of essential minerals is most important for children and younger because of the major role of these minerals in the development of body [1]. Micronutrient deficiencies play a major role in the global disease burden [2]. Insufficient intake of essential minerals in growing period, especially of Iron (Fe) and Calcium (Ca), is related to illness such as anemia, osteoporosis or immune system diseases. In dietary intake milk and other dairy products are considered as the major dietary source of minerals and trace elements. In most of the European countries milk and dairy products are an important source of dietary minerals, accounting for 10-20% of daily dietary intake of minerals and other trace elements. Buffalo milk is natural beverage that can be consumed like other products. Several essential minerals like Ca, Mg, P and Zn are found in milk and dairy products [3]. At the normal conditions buffalo milk contains (240) mg/ 100g Calcium, (30.00) mg/ 100gm Mg, (268.00) mg/ 100gm Phosphorus, (107.00) mg/ 100gm potassium and (65.00) mg/ 100gm sodium [4,5]. The aim of this study was to evaluate the daily intake of buffalo's milk and its contribution in the Recommended Daily Allowance (RDA) values of some essential minerals required for the 1-12 years children.

MATERIALS AND METHODS

Milk sample collection

A total of 30 Buffalo's Milk (BM) samples were collected from different shops of urban areas of District Jamshoro. All the milk samples were collected in sterilized plastic type bags and brought to the laboratory of Institute of Biochemistry University of Sindh for mineral analysis.

Sample preparation for mineral analysis

All the collected milk samples were prepared for mineral analysis by using Association of Official Analytical Chemistry (AOAC) reported method [6] for which 10 ml of each milk sample were digested by adding 5 ml of concentrated HNO_3 and then the mixture was transferred to muffle furnace and heated at high temperature $450^\circ C$ for 12 h. After mineralization 5ml of 10% HCl was added and mixture was heated. Finally solution was filtered and final volume was made by using deionized water and Quantitative analysis of (Cu, Zn, Ca, Mg, P, Na and K) was performed by using Perkin Elmer Atomic absorption spectrophotometer.

Daily intake of milk and essential minerals

For the determination of daily intake of milk for children a simple type of questionnaire was designed to ask about the age daily intake of

milk (liters/day). Based on the milk consumption data, Daily Intake (DI) of essential minerals were determined by using formula

$$DI = C_{\text{trace elements}} \times \text{Milk intake}$$

C = Concentration of essential minerals (mg/ kg)

DI = Daily intake of (lit/ day)

2.4. Statistical analysis

The concentrations were expressed as mean \pm SD and minimum/maximum values. The data was analyzed by using IBM SPSS Inc., Chicago, Ill, USA).

RESULTS AND DISCUSSION

Essential minerals in milk

Average concentration of Cu, Zn Ca, Mg, P, Na and K in buffalo's milk collected from urban area of District Jamshoro is summarized in table 1. Cu values obtained in present study ranged from 0.13 to 0.97 mg/ kg with mean concentration 0.396 ± 0.272 mg/ kg, these values were above the permissible limits of copper recommended by international dairy federation [7,8].

Zn content in buffalo's milk ranged from 1.4-3.82 mg/ kg with mean value 2.60 ± 0.723 mg/ kg. Results obtained for Zn in were higher than the earlier reports of [9,10] and lower than standards of [7].

Ca is major essential mineral in buffalo milk, it is the integral component of body skeleton; about 90% of total body calcium is present in bones and teeth [11]. The Ca level in buffalo's milk ranged from 735.24-1612.18 mg/kg with mean concentration 1177.06 ± 272.8 mg/ kg. About 70% of Ca comes from milk and other dairy products [12]. Reported values of Ca in present study were lower than those obtained by [13-15].

Table 1: Average concentration of essential minerals in milk samples.

Mineral	Minimum (mg/ kg)	Maximum (mg/ kg)	Mean \pm SD (mg/ kg)
Cu	0.13	0.97	0.396 ± 0.272
Zn	1.46	3.82	2.60 ± 0.723
Ca	735.24	1612.18	1177.06 ± 272.8
Mg	105.88	199.07	146.8 ± 32.1
P	544.89	962.14	761.86 ± 130.7
Na	188.67	483.63	375.74 ± 67.5
K	1222.88	1698.54	1466.23 ± 112.7

Concentration of Mg in buffalo's milk was in the range of 105 - 199.07 mg/kg, with mean concentration 146.8 ± 32.1 which is lower than those obtained by [15].

Phosphorus (P) was in the range of 544.89 - 962.1 mg/ kg with average concentration of 761.86 ± 130.7 mg/ kg in buffalo's milk. Phosphorus as phosphate is an essential nutrient involved in many physiological processes, such as cellular energy cycle, regulation of acid-base balance, as a component of cell membranes (phospholipids), in cell regulation and signalling, and in the mineralization of bones and teeth [16].

Na content in the buffalo's milk was in the range of 188.6-483.63

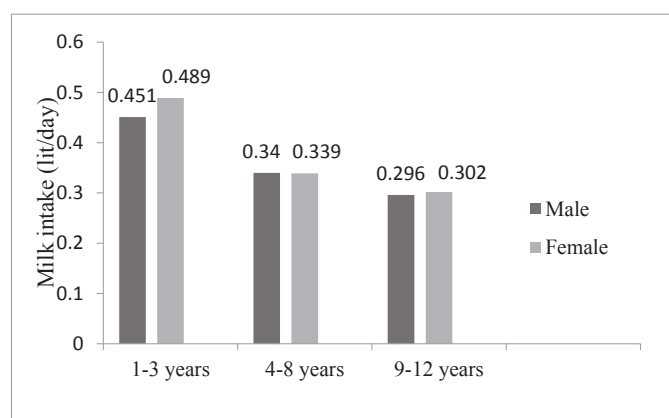


Figure 1: Average daily intake of milk in 1-12 years age group children.

mg/ kg with mean value 375.74 ± 67.5 mg/ kg. These values are lower than the previous work [17].

K values in the buffalo's milk ranged from 1222.88 to 1698.54 mg/ kg with the mean level 1466.23 ± 112.7 mg/ kg. Current value for K in milk was higher than those reported by [18,19,15]. Potassium is essential mineral, supports in the electrical activity in the nerve fibers and muscle cells of body [20].

Daily intake of milk

Average daily intake of buffalo's milk for 1-12 years age children is reported in figure 1. Highest daily milk intake was 0.45 ± 0.07 lit/ day for male and 0.48 ± 0.06 lit/ day for female in 1-3 years children, while the lowest daily milk intake was 0.296 ± 0.07 lit/ day for male and 0.302 ± 0.02 lit/ day for female in 9-12 years children. Gender wise comparison showed that female children had higher intake of milk compared to male children. Variation in milk intake in children may be due to dislike of flavour or usage of sugar containing soft drinks [21]. The Dietary Guidelines for Americans recommended that children aged 2 to 8 years consume 2 cups/day fat free or low fat milk or equivalent dairy servings. Milk plays a major role in treating under nutrition in children and adults [22].

Daily intake of essential minerals and their RDA values

Summary of the daily intake and RDA values of Cu, Zn, Ca, Mg, P, Na and K for 1-12 years children from urban area of District Jamshoro is given in table 2 and 3. The highest DI value of Cu via milk consumption was 0.194 mg/ day which corresponds to 57.06% of RDA for 1-3 years children, while the lowest DI value of copper was

Table 2: Average daily intake of Cu, Zn, Ca, Mg, P, Na and K for 1-12 years children.

Minerals	1-3 years		4-8 years		9-12 years	
	Male	Female	Male	Female	Male	Female
Cu						
DI	0.179 ± 0.02	0.194 ± 0.04	0.135 ± 0.02	0.134 ± 0.05	0.117 ± 0.03	0.119 ± 0.02
Ref. Range	0.34	0.34	0.44	0.44	0.7	0.7
Zn						
DI	1.174 ± 0.19	1.273 ± 0.29	0.886 ± 0.18	0.882 ± 0.21	0.770 ± 0.17	0.786 ± 0.19
Ref. Range	3.0	3.0	5.0	5.0	8.0	8.0
Ca						
DI	530.85 ± 88.2	575.58 ± 131.3	400.20 ± 84.3	399.02 ± 98.4	348.41 ± 77.6	355.47 ± 85.5
Ref. Range	700	700	1000	1000	1300	1300
Mg						
DI	66.21 ± 11.0	71.79 ± 16.3	49.92 ± 10.5	49.77 ± 12.3	43.45 ± 9.6	44.33 ± 10.6
Ref. Range	170	170	230	230	350	250
P						
DI	343.59 ± 57.2	372.55 ± 85.0	259.03 ± 54.6	258.27 ± 63.7	225.51 ± 50.2	230.08 ± 55.4
Ref. Range	460	460	500	500	1250	1250
Na						
DI	169.46 ± 28.2	183.74 ± 41.9	127.75 ± 26.9	127.37 ± 31.4	111.22 ± 24.8	113.47 ± 27.3
Ref. Range	1000	1000	1200	1200	1500	1500
K						
DI	661.27 ± 109	716.99 ± 163.6	498.52 ± 105.2	497.05 ± 122.7	434.01 ± 96.7	442.81 ± 106.5
Ref. Range	3000	3000	3800	3800	4500	4500

DI: Daily Intake (mg/ day), Reference range recommended by (IOM, 2011).

Table 3: RDA (%) values for Cu, Zn, Ca, Mg, P, Na and K for 1-12 years children.

Minerals	1-3 years		4-8 years		9-12 years	
	Male	Female	Male	Female	Male	Female
Cu	52.65	57.06	30.68	30.45	15.29	17.01
Zn	39.13	42.43	17.72	17.64	9.63	9.83
Ca	75.71	82.14	40.0	39.90	26.76	27.34
Mg	38.95	42.23	21.70	21.64	12.41	17.73
P	74.69	80.98	51.81	51.65	18.04	18.41
Na	16.95	18.37	10.65	10.61	7.41	7.55
K	22.04	23.89	13.12	13.08	9.64	9.82

RDA: Recommended Daily Allowance.

0.107mg/ day which is about 15.29% of RDA for 9-12 years children. The DI values of Cu were below their respective range of [23] in all age group of children.

Zinc is required for the integration of many physiological systems [24], it has also catalytic role in each class of enzymes [25]. The highest DI value of Zn via milk intake was 1.273 mg/ day which represents about 42.43% of RDA for 1-3 years children and lowest daily intake of zinc was 0.770 mg/ day, which is about 9.625% of RDA for 9-12 years children. The provisional maximum tolerable daily intake of zinc set by [26] is 0.3 mg/ kg/ bw/ day which is higher than the current DI values of zinc. Various studies like [2,27] had associated zinc intake with reduced incidence, severity and mortality due to diarrhoea.

The highest daily intake of calcium was 575.58 mg/ day which accounts for 82.23% of RDA in 1-3 years children and the lowest intake of calcium was 348.41 mg/ day which represents about 26.80% RDA of calcium in 9-12 years children. The current DI values of calcium in 1-12 years age group children were lower than recommended daily allowance of calcium recommended by [23]. Upper tolerable intake limit of calcium set by [28] is 2500 mg/ day for 1-8 years and 3000 mg/ day for 9-18 years, these values are much higher than the present findings. About 70% of calcium intake in developed countries is obtained from milk and milk products [29].

The highest daily intake of magnesium and phosphorous was 71.79 and 372.55 mg/ day, these values represent 38.94% and 80.98% of RDA for magnesium and phosphorous in 1-3 years children. The lowest daily intake of magnesium and phosphorous was 43.45 mg/ day and 225.51 mg/ day, which corresponds to 12.41% and 18.04% RDA of magnesium and phosphorous in 9-12 years children. In Western countries milk and dairy products account 16-21% for magnesium and 30-45% for phosphorous intake [30,31].

Sodium and potassium are interrelated, essential nutrients that play vital functional roles in the body, including being important for nerve signal transmission, muscle contraction, and fluid balance. Highest daily intake values of sodium and potassium were 183.74 and 716.99 mg/ day, these accounts for 18.37% and 23.89% of RDA for 1-3 years children. Lowest daily intake of Na and K was 111.2 and 434.01 mg/ day, which are about 7.41% and 9.64% of RDA for 9-13 years children.

CONCLUSION

The present study may be concluded that the daily intake of essential minerals was higher in 1-3 years age group children followed by 4-8 and 9-12 years children. Furthermore it was noticed

that daily intake of essential mineral through milk consumption in all age groups was lower than their recommended reference ranges. In RDA contribution results revealed that buffalo's milk had good contribution for Ca followed by P, Cu, Mg, Zn, K and Na for all age group children.

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