Immunonutrient Constituents of Human Colostrum

SK. Nazrul Islam[1], Luthfor Ahmed[1], Md. Nazrul Islam Khan[1], Saiful Huque[1], Rubena Haque[1], Habiba Halim[1] and Monira Ahsan[2]*

Institute of Nutrition and Food Science, University of Dhaka, Dhaka-1000, Bangladesh[1]
Department of Pharmacy, University of Dhaka, Dhaka-1000, Bangladesh[2]

Abstract

The immunonutrient (Cu, Zn, Fe, vitamin E, C, A) constituents of colostrum from twentyseven post-partum mothers were analysed and examined in relation to maternal age, parity and BMI. HPLC was employed to analyse the colostral vitamin E and A, and spectrophotometric method was used for estimation of ascorbic acid level. The Cu, Zn and Fe contents of colostrum were determined by atomic absorption flamme spectrophometry. The colostrum concentrations of vitamin E, C and A were 25.51 ± 11.21μmol/L, 216.96 ± 87.72 μmol/L, 0.65 ± 0.29 μmol/L respectively. The Cu, Zn and Fe contents of colostrum were 10.94 ± 5.94 μmol/L, 65.82 ± 20.63μmol/L, 21.54 ± 7.30μmol/L respectively. No significant relationship was found between maternal age, parity, BMI and the elemental content of colostrum. Significant correlation was found between ascorbic acid and parity (P>0.05).

Key words : Human Colostrum, Immunonutrients, Antioxidant Micronutrients

Introduction

Human colostrum contains all of the constituents that are required for optimal growth and development of a neonate. They support development of immune system providing both specific and non-specific immunities[1]. Colostrum is the first defence for the newborn. It stimulates the newborn's immune system, and affords immunity to the external mucosal surface of the intestine and to the respiratory tract of the newborn[1]. It has also unique protective effect against acute infections[2-5]. In addition to the non-nutritive bioactive components (like the immunoglobulins), colostrum contains a large number of immunoactive nutrients including antioxidant micronutrients. Antioxidant vitamins and minerals play an important role in immunophysiological functions acting as potential immunoenhancers and antioxidants[6,7], deficiencies of which down-regulates immune function, but their overload is immunotoxic[8-11]. In view of their important role in immunophysiological

Bangladesh Journal of Nutrition. Vol 16 December 2003. Institute of Nutrition and Food Science, University of Dhaka-1000, Bangladesh

* Author for correspondence

system, colostrum concentrations of vitamin E, C, A, and minerals like copper, zinc, iron, and the correlation between maternal characteristics and nutrient content of colostrum were investigated among selected Bangladeshi mothers.

Materials and Methods

Study population

The study was conducted amongst twentyseven post-partum mothers of age 16 to 40 years, who delivered their babies at the Maternity and Child Health Training Center, Azimpur, Dhaka. They belonged to low to mid socioeconomic group. Those, who voluntered as participants selected randomly irrespective of their biological condition. Women suffering from any breast or systemic diseases were not included in the study. Informed consent was obtained from the participating mothers. Colostrum (2ml) was collected by hand expressed into an acid washed glass vials on the 2^{nd} post-partum day during their stay in the post-natal ward. Privacy of the mothers was maintained. Anthropometric data, age and parity of each of the mothers were recorded. To conduct the study, ethical permission was taken from Bangladesh Medical Research Council (BMRC), Dhaka.

Colostrul analysis

Retionol and α-tocopherol. Colostrum samples were preserved at -20^0C for analysis of retinol and α-tocopherol. Reversed phase HPLC (LC-10AD, SHIMADZU, HPLC 1991, Model-7125, Japan) was used for simultaneous determination of retinol and α-tocopherol in the colostrum as described by Islam et al[6]. The retinol and α-tocopherol extracted from the colostrum was injected into chromatography on a C_{18} shim pack column with methanol:water (95:5) mobile phase. Retinol and α-tocopherol were detected spectrophotometrically at 291nm. To verify the assay accuracy, standard analytes retinol and α-tocopherol (Sigma Chemical Co, USA) were injected for every 10 test samples.

Ascorbic acid. The concentration of ascorbic acid in the colostrum was determined by spectrophotometric method using phenyl hydrazine indicator (Sigma Chemical Co, USA) as described by Islam et al[6]. Absorbance was measured against a reagent blank at 520nm by a Spectrophotometer (UV-1201, UV-VIS, Shimadzu, Japan).

Zinc, Copper and Iron. To analyse the colostral mineral contents, 1ml colostrum was acid digested using an acid mixture in block heater to make a clear solution. Concentrations of copper, zinc and iron in the colostrum were then determined by an

atomic absorption flamme emission spectrophotometer (AA-6200 Series, Shimadzu Corporation, Kyoto, Japan) as described by Picciano and Guthrie[12] using standard copper, zinc and iron (Sigma Chemicals Co, USA). Absorbances of copper, zinc and iron were read at 324.8nm, 213.9nm and 248.3nm respectively. To verify the assay accuracy and quality, the standard mineral preparations were run for every 10 test samples. A software package (AA-6200, ver 1.1, Shimadzu Corporation, Kyoto, Japan) was used to calculate the minerals concentrations.

Statistical analysis

SPSS software package (version 10.0, SPSS Inc. Chicago, USA) was used to analyse the data. Descriptive statistics were calculated for all variables. Values were expressed as percentage and mean±sd. Non-parametric analysis (χ^2 test) was performed to assess the association of colostral micronutrients with maternal characteristics. Linear regression analysis was performed to find the extent of influence of maternal characteristic on the immunonutrients (if any).

Results

Maternal charateristics of the study population are shown in the table1. The mean maternal age, parity and BMI were 25.04 ± 5.43 years, 1.52 ± 1.01 and 23.44 ± 3.73 respectively. Most of the mothers were young (16-24 years) having normal BMI (18.5-25) and were primi parae. Table 2 shows the immunonutrient profile of colostrum. The concentrations of vitamin E, C and A in colostrum were 25.51 ± 11.21μmol/L, 216.96 ± 87.72 μmol/L, 0.65 ± 0.29 μmol/L respectively. The Cu, Zn and Fe content of colostrum was 10.94 ± 5.94 μmol/L, 65.82 ± 20.63μmol/L, 21.54 ± 7.30μmol/L respectively. Non-parametric analysis showed no significant relationship between maternal age, parity, BMI and the elemental content of colostrum (table 3). Significant association was found between ascorbic acid and parity (χ^2 =21.55). Though χ^2 values did not indicate any significant association of age with vitamin E, and parity with Zn, but their 'r' values (-0.97, -0.32) showed certain negative correlation. Based on these findings, linear regression analysis was done, which exhibited regression co-efficient β= -0.645 with P=0.003 and R^2 =0.307 for ascorbic acid and parity. But regression co-efficient between age and vitamin E (β= -0.112 with P=0.632 and R^2 =0.009), and that between parity and Zn (β= -0.211 with P=0.211, R^2 =0.062) were found to be insignificant.

Table 1: Socio-demographic characteristics of the mothers under study

Characteristic	Number (%)	Mean ± sd	Total Mean ± sd
Age in year			
16-24	14(52)	25.57 ± 2.03	25.04 ± 5.43
24-32	10(37)	28.30 ± 1.82	
32-40	3 (11)	35.00 ± 0.00	
Parity			
Primi	19(70.4)	1 ± 0.00	1.52 ± 1.01
Multi	8(29.6)	2.75 ± 1.01	
BMI			
16-18.5	4 (15)	18.34 ± 4.10	23.44 ± 3.73
18.5-25	16 (59)	21.94 ± 1.69	
>25	7 (26)	28.32 ± 2.52	

Table 2: Micronutrient profile of human colostrum

Micronutrient in µmol/L	Number (%)	Mean ± sd	Total Mean ± sd
Vitamin E			
≤18.8	9(33)	13.67 ± 2.49	25.51 ± 11.21
18.8-30.00	10(37)	24.69 ± 1.76	
30.00 and above	8(30)	39.84 ± 6.31	
Vitamin C			
≤116.00	1(4)	95.96 ± 0.00	216.96 ± 87.72
116.00-162.00	6(22)	143.46 ± 16.81	
162 and above	20(74)	245.06 ± 84.53	
Vitamin A			
≤0.81	19(70)	0.51 ± 0.16	0.65 ± 0.29
0.81-1.34	7(26)	0.90 ± 0.01	
1.34 and above	1(4)	1.65 ± 0.00	
Copper			
≤15.00	19(70)	8.05 ± 4.53	10.94 ± 5.94
15.00-27.00	8(30)	17.821.25	
Zinc			
≤62.00	11(41)	44.95 ± 10.14	65.82 ± 20.63
62.00-77.00	6(22)	65.69 ± 5.35	
77.00 and above	10(37)	87.82 ± 53.46	
Iron			
≤10.60	2(7)	8.91 ± 0.00	21.54 ± 7.30
10.60-12.50	1(4)	11.14 ± 0.00	
12.50 and above	24(89)	23.03 ± 6.28	

Table 3. Correlation of colostral micronutrient profile with maternal characteristics

Maternal characteristic	χ^2					
	Vitamin E	Vitamin C	Vitamin A	Copper	Zinc	Iron
BMI	5.94	1.86	0.86	0.56	3.14	1.92
	(0.08)	(0.19)	(0.09)	(0.27)	(0.09)	(0.10)
Age	6.43	1.86	8.88	3.59	0.29	1.30
	(-0.97)	(0.19)	(0.17)	(0.27)	(0.04)	(0.09)
Parity	1.89	21.55*	(6.98)	2.26	3.80	1.43
	(-0.05)	(-0.57)	(0.15)	(0.27)	(-0.32)	(-0.02)

[a] $\chi^2 \geq 9.488$ at 4 df (degree of freedom) is significant. *Significant Figure in parenthesis are r-values.

Discussion

The mean concentration reported in the study for vitamin E in colostrum was found to be much higher than the values reported for milk[13-16], but is in agreement with the concentration claimed elsewhere for colostrum[14]. Concentrations of vitamin C and A in the colostrum were similar to those reported for Bangladesh[16] and India[17], but these values are lower than those reported for the developed and developing countries[18,19]. However, the mineral values obtained in the present study are consistent with the data reported in other studies [20,21]. Correlation between maternal characteristic (i.e. age, parity and BMI) and the concentrational values of colostral micronutrients, except for ascorbic acid with parity, could not be ascertained. This outcome is matched up to some extent with the findings of other researchers[22]. The reason for positive association of vitamin C with parity (χ^2 =21.55) is not clear. However, it is reported that breasts may be able to actively secrete ascorbic acid in pregnancy[23].

It is to be concluded that human colostrum is rich in antioxidant immunonutrients, which play an important role in the growth, development and immunity of infant's life. It further revealed that colostral concentration of micronutrients is universal and is independent of nutritional status, age or parity of mothers. This finding is of considerable public health significance. Promotion of colostrum feeding will ensure child survival, growth and development irrespective of social strata.

Acknowledgement

The authors thank the financial support by the Bangladesh Breastfeeding Foundation.

References

1. Ogra SS and Ogra PL. Immunologic aspects of human colostrum and milk. J. Padiatr. 1978; 92(4): 546-549.
2. Grover M, Giouzeppos O, Schnagl RD and May JT. Effect of human milk postaglandins and lactoferrin on respiratory syncytial virus and rotavirus. Acta Padiatr. 1997; 86: 315-316.
3. Lawton JWM and Shortridge KF. Protective factors in human breast milk and colostrum. The Lancet 1977; Jan 29: 253.
4. Mathur NB, Dwarkadas AM, Sharma VK and Jain N. Anti-infective factors in preterm human colostrum. Acta Padiatr. Scan. 1990; 79(11): 1039-1044.
5. Hanson LA. The mammary gland as an immunological organ. Immunol. Today 1982; 3(6):168-172.
6. Islam SN, Hossain KJ and Ahsan M. Original Communication: Serum vitamin E, C and A status of the drug addicts undergoing detoxification: influence of drug habit, sexual practice and lifestyle factors. Eur. J. Clin. Nutr. 2001; 55: 1022-1027.
7. Czerinichow S and Hercberg S. International studies concerning the role of antioxidant vitamins in cardiovascular diseases: a review. J. Nutr. Health. Aging 2001; 5(3): 188-195.
8. Shankar AH and Prasad AS. Zinc and immune function: the biological basis of altered resistance to infection. Am. J. Clin. Nutr. 1998; 68(suppl): 447S-463S.
9. Chandra RK. Nutrition and the immune system: an introduction. Am. J. Clin. Nutr. 1997; 66: 460S-463S.
10. Scrimshaw NS and SanGiovanni JP. Synergism of nutrition, infection, and immunity: an overview. Am. J. Clin. Nutr. 1997; 66(suppl): 464S-477S.
11. Chandra RK. Introduction and state of the art and science of nutrition and immunology. Ann. Nutr. Metab. 2001; 45(suppl 1): 288.
12. Picciano MF and Guthrie HA. Copper, iron and zinc contents of mature human milk. Am. J. Clin. Nutr. 1976; 29: 242-254.
13. Lammi-Keefe CJ and Borum PR. Anaysis of fat soluble vitamins in human milk: vitamin E and vitamin A. In: Jensen RG, Neville MC eds. Human Lactation. New York: Plenum Press. 1985:185-190.
14. Jansson L, Akesson B and Halmberg L. Vitamin E and fatty acid composition of human milk. Am. J. Clin. Nutr. 1981; 34:8-13.
15. Jelliffe DB and Jelliffe EFP. Biochemical considerations. In: Human milk in the modern world. New York: Oxford University Press. 1979:26-58.
16. Ahmed L, Islam SN and Nahid SN. Differentials in vitamin C composition of human milk (colostrum, transitional and mature) and serum. Malaysian J. Nulr. 2004 (in press).

17. Newman V. Vitamin A and breastfeeding: a comparison of data from developed and developing countries. San Diego, CA: Wellstart International, USAID, Appendix C. 1993a: 68.

18. Newman V. Vitamin A and breastfeeding: a comparison of data from developed and developing countries. San Diego, CA: Wellstart International, USAID. 1993b: 22-23.

19. Kirksy A and Udipi SA. Anaysis of water soluble vitamins in human milk: vitamin B-6 and vitamin C. In: Jensen RG, Neville MC eds. Human Lactation. New York: Plenum Press. 1985: 153-170.

20. Hurley LS and Lonnerdal B. Trace element in human milk. In: Hanson LA ed. Biology of human milk, Nestle Nutrition, Workshop series, vol 15. New York: Raven press. 1988: 75-94.

21. Casey CE, Hambidge KM and Neville MC. Studies in human lactation: zinc, copper, manganese and chromium in human milk in the first month of lactation. Am. J. Clin. Nutr. 1985; 41: 1193-2000.

22. Garg M, Thirupuram S and Shaha K. Colostrum composition, maternal diet and nutrition in North India. J. Trop. Pad. 1988; 34: 79-87.

23. Jelliffe DB and Jelliffe EFP. The volume and composition of human milk in poorly nourished communities : A Review. Am. J. Clin. Nutr. 1978; 31 : 492-515.