NUTRIENTS | 中国城市母亲母乳的氨基酸组成

本文关键字：母乳、氨基酸、哺乳期、横断面研究

影响因子：4.196

建议阅读时间：1 分钟

母乳（BM）中的氨基酸（AA）成分可能会受到哺乳阶段或与地理位置相关的因素影响。这项横断面研究旨在评估中国城市母亲 BMAA 随着哺乳阶段而发生的变化。利用邻苯二醛/芴甲基氯甲酸酯（OPA/FMOC）衍生化分析了在中国三个城市收集的 450 份覆盖了 0-8 个月泌乳阶段的母乳样品，并对其进行了游离氨基酸（FAA）和总氨基酸（TAA）分析，泌乳浓度与泌乳量的变化与以往的报告一致。

在哺乳前期，总的和单次的 TAA 值都显著降低，之后基本趋于平稳状态。在所有的泌乳阶段，亮氨酸和蛋氨酸分别是最丰富和最不丰富的必需氨基酸，而谷氨酸+谷氨酰胺（Glx）数量最多，胱氨酸含量最低。游离氨基酸（FAA）占总氨基酸数量的不足 2%，但游离谷氨酰胺除外，它是含量最为丰富的游离氨基酸。

总之，对来源于中国城市母亲母乳中的氨基酸成分后发现，其与之前在世界其他地区进行的前期研究的结果基本一致，表明这是一种进化过程中保守的特性，不受地域、种族或饮食因素的影响。

Table 1. Maternal and infant characteristics.

	Lactation Period					
	5–11 Days	12–30 Days	1–2 Months	2–4 Months	4–8 Months	*p* Value
	(*n* = 90)	(*n* = 90)	(*n* = 90)	(*n* = 90)	(*n* = 90)	
MOTHER						
Age (years), Mean (SD)	27 (4)	27 (3)	28 (4)	27 (4)	26 (4)	0.005
Height (cm), Mean (SD)	160 (4)	160 (5)	161 (5)	161 (5)	159 (5)	0.102
Weight (kg), Mean (SD)	60.7 (8.7)	60.8 (7.9)	61.9 (8.9)	58.4 (8.3)	56.2 (8.1)	<0.001
BMI (kg/m^2), Mean (SD)	23.7 (3.2)	23.7 (3.0)	23.9 (3.1)	22.5 (2.9)	22.2 (3.1)	<0.001
Gestational weight gain (kg), Mean (SD)	16.7 (7.4)	16.2 (6.0)	15.9 (5.7)	15.9 (5.9)	14.9 (7.6)	0.419
Postpartum weight loss (kg), Mean (SD)	9.1 (6.1)	8.6 (5.3)	9.8 (4.0)	10.0 (6.2)	10.6 (5.9)	0.119
Non-Smoker, *n* (%)	90 (100)	89 (99)	90 (100)	86 (98)	89 (100)	0.176
Cesarean delivery, *n* (%)	39 (42)	43 (48)	53 (59)	35 (39)	35 (38)	0.004
Household income (RMB/month)						
<2000 RMB, *n* (%)	20 (22)	17 (19)	24 (27)	26 (29)	31 (34)	
2000–4000 RMB, *n* (%)	37 (41)	45 (50)	41 (46)	40 (44)	41 (46)	
>4000 RMB, *n* (%)	30 (33)	22 (24)	23 (26)	22 (24)	18 (20)	
Unknown, *n* (%)	1 (1)	6 (7)	2 (2)	0 (0)	0 (0)	0.206
INFANT						
Males, *n* (%)	51 (57)	48 (53)	48 (53)	54 (60)	43 (48)	0.865
Gestational age at birth (weeks), Mean (SD)	39.3 (1.2)	39.2 (1.3)	39.2 (1.6)	39.4 (1.3)	39.5 (1.5)	0.684

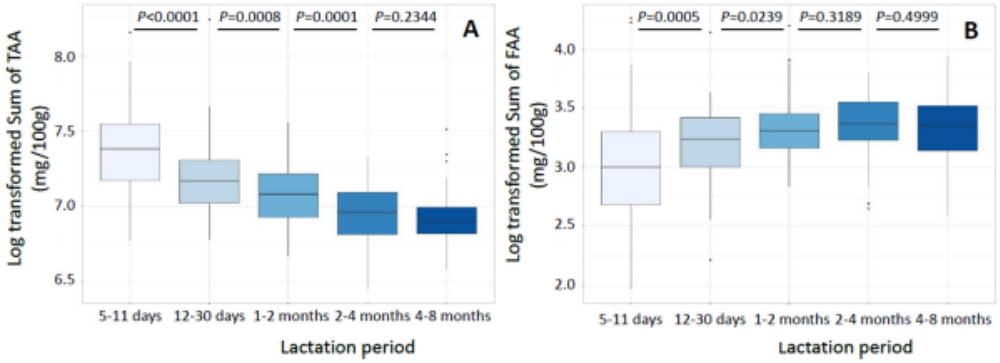

Figure 2. Box plot of the log-transformed sum of total (TAA, (**A**)) and of free (FAA, (**B**)) amino acids in milk from the different lactation periods. $n = 90$ milk samples per lactation period. Statistically significant differences between two periods were set at $p < 0.05$.

Table 2. Total amino acid content (mg/100 g) of milk from the different lactation periods.

	Lactation Period				
	5–11 Days	**12–30 Days**	**1–2 Months**	**2–4 Months**	**4–8 Months**
IAA †					
Histidine	51.2 (19.9)	44.5 § (14.1)	36.5 § (12.6)	34.9 § (7.2)	25.0 § (6.8)
Isoleucine	81.0 (23.4)	71.6 § (15.4)	64.6 § (16.8)	54.0 § (11.6)	53.8 (10.7)
Leucine	153.7 (63.2)	133.7 § (35.1)	130.3 (33.5)	108.1 § (24.9)	122.6 § (38.8)
Lysine	112.0 (31.0)	93.8 § (23.1)	78.8 § (18.9)	63.4 § (13.1)	67.9 § (13.1)
Methionine	21.8 (11.7)	16.7 § (6.6)	13.0 § (9.0)	9.2 § (6.1)	11.8 § (7.1)
Phenylalanine	64.4 (35.9)	52.4 § (18.3)	40.4 § (13.6)	37.6 § (10.8)	28.4 § (9.0)
Threonine	85.1 (28.1)	66.9 § (14.6)	58.0 § (13.3)	50.0 § (8.7)	48.6 (11.3)
Valine	97.9 (34.3)	81.1 § (16.7)	72.1 § (21.0)	59.7 § (16.0)	60.9 (12.7)
DAA †					
Alanine	70.9 (23.0)	55.9 § (14.3)	45.9 § (15.7)	38.7 § (10.9)	38.6 (9.1)
Arginine	106.5 (36.6)	90.8 § (22.8)	77.0 § (24.5)	64.6 § (21.3)	65.3 (16.7)
Asx ‡	132.9 (84.1)	115.5 § (54.4)	106.9 (40.0)	97.2 (56.8)	83.8 § (24.6)
Cystine	25.4 (12.5)	17.7 § (6.3)	12.5 § (5.2)	12.3 (3.4)	9.9 § (5.5)
Glx ‡	248.1 (193.7)	220.1 § (92.4)	216.3 (59.3)	188.6 (105.2)	182.8 § (30.8)
Glycine	46.3 (15.2)	34.5 § (9.7)	27.6 § (10.5)	23.6 § (7.0)	23.5 (6.8)
Proline	140.2 (42.4)	117.7 § (26.5)	110.6 § (25.4)	95.3 § (20.9)	94.5 (17.2)
Serine	77.8 (27.0)	59.0 § (14.1)	47.9 § (9.8)	42.9 § (8.1)	41.7 (8.0)
Tyrosine	72.5 (30.4)	57.7 § (14.1)	44.1 § (19.5)	41.4 (13.9)	37.1 § (10.3)
SUM	1608.3 (589.5)	1296.5 § (368.4)	1188.1 § (341.7)	1053.2 § (291.9)	992.4 (175.9)

† IAA = indispensable amino acids; DAA = dispensable amino acid; ‡ Asx = sum of aspartic acid + asparagine; Glx = sum of glutamic acid + glutamine. Medians (inter-quartile ranges) of $n = 90$ samples per lactation period are shown. A median with a "§" superscript is significantly different from the median of the previous lactation period ($p < 0.05$).

Table 3. Free AA content (mg/100 g) of milk from the different lactation periods.

	Lactation Period				
	5–11 Days	**12–30 Days**	**1–2 Months**	**2–4 Months**	**4–8 Months**
IAA †					
Histidine	0.29 (0.21)	0.42 § (0.23)	0.33 § (0.15)	0.33 (0.19)	0.28 (0.10)
Isoleucine	0.17 (0.11)	0.19 (0.13)	0.13 § (0.10)	0.13 (0.07)	0.15 § (0.07)
Leucine	0.33 (0.20)	0.4 (0.2)	0.34 § (0.14)	0.33 (0.14)	0.34 (0.15)
Lysine	0.61 (0.51)	0.56 § (0.28)	0.46 § (0.20)	0.42 § (0.23)	0.54 § (0.28)
Methionine	0.11 (0.07)	0.13 (0.13)	0.10 § (0.07)	0.07 § (0.06)	0.12 § (0.05)
Phenylalanine	0.31 (0.17)	0.40 (0.17)	0.32 § (0.17)	0.33 (0.17)	0.30 (0.12)
Threonine	0.69 (0.38)	0.69 (0.36)	0.70 (0.36)	0.78 (0.34)	0.85 (0.38)
Valine	0.58 (0.27)	0.70 § (0.30)	0.61 § (0.21)	0.59 (0.21)	0.59 (0.18)
DAA †					
Alanine	1.26 (0.81)	1.75 § (0.79)	2.07 § (0.67)	1.93 (0.68)	1.85 (0.46)
Arginine	0.46 (0.49)	0.42 § (0.28)	0.25 § (0.22)	0.25 (0.19)	0.25 (0.13)
Asx ‡	0.47 (0.36)	0.52 (0.30)	0.54 (0.35)	0.55 (0.38)	0.58 (0.40)
Cystine	0.32 (0.13)	0.49 § (0.21)	0.46 (0.17)	0.49 (0.21)	0.50 (0.15)
Glx ‡	10.89 (9.89)	15.09 § (8.74)	18.03 § (7.17)	20.22 § (7.28)	19.36 (8.07)
Glycine	0.51 (0.29)	0.62 § (0.23)	0.68 § (0.25)	0.64 (0.28)	0.76 § (0.28)
Proline	0.56 (0.33)	0.40 § (0.28)	0.54 (0.29)	0.40 (0.31)	0.45 § (0.44)
Serine	0.72 (0.43)	0.85 § (0.36)	0.91 § (0.40)	1.11 § (0.63)	1.11 (0.43)
Taurine	2.26 (2.65)	1.91 (1.78)	1.94 (1.31)	1.87 (1.42)	2.03 (1.12)
Tyrosine	0.38 (0.26)	0.40 (0.20)	0.28 § (0.17)	0.25 (0.14)	0.28 § (0.13)
SUM	20.1 (12.5)	25.5 § (10.4)	27.4 § (8.0)	29.0 (9.7)	28.6 (10.7)

† IAA = indispensable amino acids; DAA = dispensable amino acid; ‡ Asx = sum of aspartic acid + asparagine; Glx = sum of glutamic acid + glutamine. Medians (inter-quartile ranges) of $n = 90$ samples per lactation period are shown. A median with a "§" superscript is significantly different from the median of the previous lactation period ($p < 0.05$).

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