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CHANGE OF AMINO ACID PROFILE IN EGYPTIAN BUFFALOES' AND HOLSTEIN COWS' COLOSTRUM

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ABSTRACT

The changes in amino acids in colostrum and transient milk of buffaloes and cows colostrum in the first five days and after 14 days of parturition were followed. Colostrum and milk samples were collected at calving, 6, 12, 24, 48, 72, 96, 120 h and after 14 days of parturition. Amino acid concentrations (%) in samples were determined in milk protein wit an automatic amino acid analyzer. Results showed that at calving, the concentration of leucine, proline, cysteine and tyrosine was significantly higher in buffaloes than cows colostrum while the concentration of serine, glycine, alanine and arginine had the opposite trend. In post-partum period, among amino acids significant increases were observed in methionine and proline and significant decreases were recorded in threonine and serine of both colostrums. Arginine of both colostrums, glycine and alainine of buffaloes colostrum and cysteine and tyrosine of cows colostrum fluctuated within the times of study, while leucine, lysine, glutamic of buffaloes and aspartic of cows colostrum revealed no significant differences during the experimental period. On the fifth day, the buffaloes milk was characterized by a significant higher isoleucine, histidine, proline, cysteine, tyrosine and arginine; and a significant lower valine, glycine and alanine concentrations as compared with cows milk.
Keywords: Buffalo, cow, colostrum, amino acid profile.

INTRODUCTION

Colostrum is a nature's gift for the newborn and it is the first thick yellow lacteal secretion in all mammals immediately following the birth and continue to few days (3-4 days) after parturition (Alexieva *et al.*, 2004). First milking colostrum is an important source of nutrients and an immediate source of passively absorbed maternal antibodies, which are critical in the protection of the newborn calf against infectious diseases in the first weeks and months of life (Davis and Drackley, 1998).

Bovine colostrum contains various nutrients (proteins, essential and nonessential amino acids and fatty acids, lipids, lactose, vitamins, minerals, oligo-elements) as well as non-nutrient substances such as immunoglobulins, enzymes, nucleotides, peptides, polyamines, growth factors, hormones and cytokines, which are important for nutrient supply, specific and non-specific host defense, growth and development, i.e. for overall adaptation of neonatal calves to the new environmental factors after birth related to drastic change from primarily parenteral nutrition during fetal period to exlusively enteral provision of nutrients at birth (Levieux, 1999; Blum & Baumrucker, 2002; Blum *et al.*, 2002).

In ruminants, rumen microorganisms are able to produce amino acids that are essential for non-ruminant species. At this age, however, the rumen functions have not been developed yet. Thus, threonine, valine, methionine,

isoleucine, leucine, phenylalanine, lysine and histidine are essential for them as it is the case in monogastric animals (Riis**,** 1984). Solymos and Horn (1994) stated that the amino acid profile in colostrum consumed at the first sucking is similar to that of uterine milk (embryotroph), except methionine and glutamic acid. Calves are born without sufficient essential amino acid supply.

Only little information is available on the colostrum amino acid profile of Egyptian buffaloes and Holstein cows, therefore the aim of this study was to follow the changes in amino acids in colostrum of buffaloes and cows colostrum in the first five days and after 14 days of parturition.

MATERIALS AND METHODS

Colostrum and milk samples from 6 buffaloes and 12 cows were collected during the winters of 2009, 2010 and 2011; totaling 18 buffaloes and 36 cows. All samples were analyzed at calving, 6, 12, 24, 48, 72, 96, 120 h and after 14 days of parturition. Egyptian buffaloes and Holstein cows were selected from open nucleus herd belongs to Cattle Information System of Egypt (CISE) and Technology Center of Agricultural Production, Faculty of Agriculture, Cairo University. All animals were in the second lactation and their milk production in the first lactation was 1880 kg/parity for buffalo and 3500 kg/parity for cow. They fed under winter feeding conditions (green grass, rice straw and concentrates) and housed in free stalls. This study followed the guidelines for care and use of animals in scientific research at Animal Production Department, Faculty of Agriculture, Cairo University.

Samples were prepared by acid hydrolysis with 6N HCl according to the method of Block *et al.* (1958). Automatic amino acid analyzer (AAA 400 INGOS Ltd.) in the amino acid analyzer lab., Faculty of Agriculture-Cairo University was used for determination of essential (threonine (Thr), valine (Val), methionine (Met), isoleucine (Ile), leucine (Leu), phenylalanine (Phe), lysine (Lys), and histidine (His)) and non-essential (cysteine (Cys), tyrosine (Tyr), aspartic (Asp), serine (Ser), glutamic (Glu), proline (Pro), glycine (Gly), alanine (Ala), arginine (Arg)) amino acids.

Data are expressed as the mean ± standard deviation (SD). A randomize complete block design with one factor (time post-partum) was used for analysis all data. The treatment means were compared by least significant differences (L.S.D.) test as given by Snedecor and Cochran (1976). An independent T-test was used to compare results of cows' and Buffaloes' colostrum. All statistical calculations were performed using Mstat-c (Mstat-c, 1989). Results were considered statistically significant at $P \leq 0.05$.

RESULTS AND DISCUSSION

Essential amino acids

Mean values and standard deviations of different essential amino acids in colostrum and transient milk protein of buffaloes and cows are presented in Table 1. At calving, the concentration of Leu was significantly higher in buffaloes than cows colostrum (Table 3).

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Regarding the level of Thr, a significant decrease was observed at 48 and 120 h of parturition in buffaloes colostrum, while it decreased significantly in cows colostrum at 12, 24, 48 h and after 14 days of parturition.

Val concentration in both colostrums showed a significant decrease at 24 h post-partum. For cows colostrum, it did not change significantly until the end of the experimental period, while Val concentration of buffaloes colostrum increased significantly at 48 h post-partum and did not change until the end of the experimental period.

A significant increase tendency was observed for Met concentration of both colostrums as the transition period advanced except there was a significant decrease at 24 h for buffaloes and at 72 h post-partum for cows colostrum.

Leu concentration of cows colostrum increased significantly at 72 h post-partum, then remained approximately constant until the end of experimental period. However, Leu concentration of buffaloes colostrum did not differ significantly during the experimental period.

A significant increase tendency was observed for Ile at 48 and 12 h post-partum for buffaloes and cows colostrum, respectively. After that, the values of Ile in both colostrums did not change significantly.

Phe concentration of buffaloes colostrum fluctuated during the experimental period, while Phe concentration of cows colostrum increased significantly at 24 h and 14 days of parturition.

His concentration of buffaloes colostrum increased significantly at 72 h then decreased significantly after 14 days of parturition, while His of cows colostrum fluctuated during the experimental period.

Lys concentration of buffaloes colostrum revealed no significant differences during the experimental period. While in cows colostrum, it increased significantly at 72 h post-partum, then remained constant.

On the fifth day, the buffaloes milk was characterized by a significant higher Ile and His; and a significant lower Val concentration as compared with cows milk.

Non-essential amino acids

Mean values and standard deviations of different non-essential amino acids in colostrum and transient milk protein of buffaloes and cows are presented in Table 2. At calving, the concentration of Pro, Cys and Tyr was significantly higher in buffaloes than cows colostrum while the concentration of Ser, Gly, Ala and Arg had the opposite trend as shown in Table 4.

Glu concentration of buffaloes colostrum remained without change throughout the period of study, while it increased significantly in cows colostrum at 24 h post-partum.

Asp concentration of buffaloes colostrum decreased significantly at 96 h post-partum, while it did not change throughout the period of study in cows colostrum.

For both colostrums, Arg concentration fluctuated during the period of study and Pro concentration increased significantly at 6 h post-partum.

Gly and Ala concentrations of buffaloes colostrum showed a fluctuation during the experimental period. In cows colostrum, Gly concentration reduced significantly at 12, 24 and 96 h postpartum, and Ala concentration decreased significantly after five days and 14 days of parturition.

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Cys and Tyr concentrations of cows colostrum fluctuated within the times of study. As for buffaloes colostrum, Tyr concentration decreased significantly at 24 h, 96 h and 14 days of parturition, while Cys concentration increased significantly at 6 h then decreased significantly until the end of the experimental period.

The concentration of Ser decreased significantly at 12 h and 14 days of parturition for buffaloes colostrum and at 24 and 120 h post-partum for cows colostrum.

On the 5th day, the buffaloes milk had a significant higher Pro, Cys, Tyr and Arg; and a significant lower Gly and Ala concentrations as compared with cows milk.

The same trend for valine, metionine, phenylalanine, lycine, aspartic, serine, glutamic, proline, glycine and arginine in cows colostrum was reported by Zándoki *et al.* (2006). Davis *et al.* (1994) recorded increasing tendencies for glutamic acid, proline, methionine, isoleucine and lysine concentration, while cysteine, glycine, serine, threonine and alanine decreased in colostrum and milk protein in the first week after calving.

Conclusion

At calving, the concentration of leucine, proline, cysteine and tyrosine was significantly higher in buffaloes than cows colostrum while the concentration of serine, glycine, alanine and arginine had the opposite trend. Data obtained showed also significant and non-significant changes in some buffaloes and cows colostrum amino acids profile. Buffaloes leucine, lycine and glutamic and cows aspartic concentrations remained constant during the experimental period. On the fifth day, the buffaloes milk was characterized by a significant higher isoleucine, histidine, proline, cysteine, tyrosine and arginine; and a significant lower valine, glycine and alanine concentrations as compared with cows milk.

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تغير الأحماض الأمينيه في السرسوب الجاموسي والبقري

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تهدف هذه الدراسه الى تتبع التغيرات التي تحدث في الأحماض الأمينيه لكل من السرسوب الجاموسي والبقري منذ الولاده ولمدة خمسة أيام وأيضا في اليوم الرابع عشر. حيث تم تجميع عينات السرسوب واللبن بعد الولاده مباشرة وبعد ٦، ١٢، ٢٤، ٤٨، ٧٢، ٩٦، ١٢٠ ساعة وفي اليوم الربع عشر من الولاده. وأظهرت النتائج أن السرسوب الجاموسي يحتوي على تركيز عالي من كل من الليوسين، البرولين، السيستئين والتيروزين، وتركيز منخفض من أحماض السيرين، الجلايسين، الألانين والأرجينين مقارنة بالسرسوب البقري وذلك بعد الولاده مباشرة. وبمضي الوقت بعد الولاده، وجد هناك زيادة معنويه في تركيز أحماض الميثيونين و البرولين وانخفاض معنوي في تركيز أحماض الثريونين والسيرين لكلا النوعين من السرسوب، بينما لم يلاحظ أي تغير معنوي في تركيز أحماض الليوسين، اللايسين والجلوتاميك للسرسوب الجاموسي والاسبرتك للسرسوب البقري. أيضا وجد أن أحماض الأرجينين لكلا النوعين من السرسوب والجلايسين والألانين للسرسوب الجاموسي وكذلك السيستئين والتيروزين للسرسوب البقري تتذبذب تركيزاتهم ما بين انخفاض وارتفاع خلال فترة الدراسة. في اليوم الخامس من الولاده، لوحظ ارتفاع تركيز أحماض الايزوليوسين، الهيستدين، البرولين، السيستئين، التيروزين والأرجينين في السرسوب الجاموسي وانخفاضه في تركيز أحماض الفالين، والجلايسين واللأنين وذلك مقارنة بالسرسوب البقري.

الكلمات الداله: الجاموس، البقر، السرسوب، مجموع الأحماض الأمينيه.

قام بتحكيم البحث

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Table 1: Essential amino acids profile in buffalo and cow colostrum and transient milk protein (Mean ± SD).

Amino acid (%)	Time (h)									LSD
	At calving	6	12	24	48	72	96	120	14d	
					Buffalo colostrum					
Thr	7.26^{a}±1.09	6.98^{a}±0.68	7.55^{a}±0.89	7.94^{a}±0.80	5.39^{b}±0.60	5.58^{b}±0.43	4.55^{bc}±0.22	4.01^{c}±0.22	3.93^{c}±0.15	1.106
Val	8.24^{a}±1.10	7.87^{a}±0.65	7.36^{a}±0.49	5.32^{c}±0.24	6.31^{b}±0.43	5.95^{bc}±0.36	6.2^{bc}±0.39	6.12^{bc}±0.50	6.16^{bc}±0.53	0.9794
Met	1.71^{h}±0.02	1.75^{g}±0.02	1.86^{e}±0.02	1.26^{i}±0.01	1.79^{f}±0.01	2.48^{d}±0.01	2.51^{c}±0.01	2.81^{b}±0.03	2.97^{a}±0.03	0.01715
Ile	4.36^{d}±0.54	4.55^{bcd}±0.26	4.88^{abcd}±0.25	4.47^{cd}±0.24	5.04^{abc}±0.43	5.24^{a}±0.23	5.1^{ab}±0.22	4.92^{abcd}±0.42	4.67^{abcd}±0.33	0.5868
Leu	9.42^{a}±1.12	9.85^{a}±1.71	10.99^{a}±1.12	10.55^{a}±1.15	10.11^{a}±1.23	9.97^{a}±0.98	10.21^{a}±1.12	10.51^{a}±1.01	10.61^{a}±1.09	2.035
Phe	4.72^{ab}±0.29	4.45^{abc}±0.25	4.08^{c}±0.36	4.18^{c}±0.22	4.81^{a}±0.50	3.57^{d}±0.13	4.23^{bc}±0.21	4.28^{bc}±0.24	4.32^{abc}±0.20	0.4912
His	3.38^{b}±0.26	3.38^{b}±0.10	3.44^{b}±0.13	3.47^{b}±0.11	3.5^{b}±0.10	3.82^{a}±0.12	3.79^{a}±0.10	3.61^{ab}±0.13	3.42^{b}±0.18	0.2301
Lys	9.35^{a}±1.61	9.56^{a}±0.99	9.73^{a}±0.79	9.36^{a}±0.69	9.66^{a}±1.10	9.73^{a}±0.61	9.43^{a}±0.97	9.14^{a}±0.80	8.85^{a}±1.18	1.736
					Cow colostrum					
Thr	7.37^{a}±0.78	6.91^{ab}±0.43	6.47^{b}±0.47	5.08^{c}±050	4.11^{de}±0.50	4.80^{cd}±0.10	4.45^{cde}±0.33	3.82^{ef}±0.22	3.24^{f}±0.10	0.7438
Val	7.38^{a}±0.89	6.89^{ab}±0.25	6.66^{abc}±0.44	5.90^{bc}±0.41	5.68^{c}±0.70	6.22^{bc}±0.50	6.23^{bc}±0.80	6.18^{bc}±0.61	6.11^{bc}±0.89	1.109
Met	0.95^{g}±0.01	1.11^{f}±0.01	1.52^{e}±0.01	1.78^{d}±0.00	1.93^{c}±0.01	1.76^{d}±0.01	2.10^{b}±0.09	2.81^{a}±0.01	2.80^{a}±0.05	0.07671
Ile	2.65^{d}±0.02	2.82^{cd}±0.03	3.23^{bc}±0.12	3.75^{ab}±0.16	3.87^{a}±0.87	4.10^{a}±0.12	3.99^{a}±0.12	4.11^{a}±0.12	4.12^{a}±0.21	0.5259
Leu	8.86^{d}±0.79	9.24^{cd}±0.80	9.32^{cd}±0.80	9.77^{bcd}±0.99	9.45^{bcd}±1.50	11.20^{abc}±1.00	10.99^{abcd}±1.15	11.56^{ab}±1.86	12.12^{a}±1.88	2.174
Phe	2.84^{c}±0.01	2.76^{c}±0.04	2.80^{c}±0.03	3.25^{b}±0.10	3.23^{b}±0.11	3.17^{b}±0.11	3.29^{b}±0.11	3.32^{b}±0.17	3.66^{a}±0.18	0.1879
His	2.67^{d}±0.02	2.57^{d}±0.03	2.60^{d}±0.01	3.27^{b}±0.10	2.96^{c}±0.04	3.18^{b}±0.19	2.99^{c}±0.09	3.30^{b}±0.10	3.57^{a}±0.15	0.1715
Lys	6.99^{b}±0.59	7.24^{b}±0.65	7.46^{ab}±0.64	7.42^{ab}±0.53	7.68^{ab}±0.62	8.84^{a}±1.04	8.79^{a}±0.95	7.89^{ab}±1.12	8.95^{a}±1.45	1.533

Means in the same raw with different superscript letters differ significantly.
SD: Standard deviation of the mean.

Table 2: Non-essential amino acids profile in buffaloes and cows colostrum and transient milk protein (Mean ± SD).

Amino acid (%)	Time (h)									LSD
	At calving	6	12	24	48	72	96	120	14d	
					Buffalo colostrum					
Asp	9.77^{ab}±1.44	9.65^{ab}±0.90	9.57^{abc}±1.09	10.68^{a}±1.30	9.07^{a-d}±0.89	8.34^{bcd}±0.88	8.01^{cd}±0.99	7.86^{cd}±0.89	7.73^{d}±0.68	1.769
Ser	8.39^{a}±1.20	7.98^{ab}±0.71	7.07^{bc}±0.86	6.81^{bcd}±0.69	6.54^{cd}±0.67	6.34^{cd}±0.32	5.99^{cd}±0.35	5.90^{cd}±0.37	5.87^{d}±0.51	1.177
Glu	16.21^{a}±2.80	17.22^{a}±2.99	18.27^{a}±3.35	18.33^{a}±2.90	19.05^{a}±3.86	18.91^{a}±2.10	19.05^{a}±2.10	19.40^{a}±2.12	18.74^{a}±1.99	4.735
Pro	1.75^{f}±0.01	1.81^{e}±0.01	1.96^{d}±0.05	2.14^{c}±0.01	2.01^{d}±0.04	2.00^{d}±0.01	2.12^{c}±0.03	2.36^{b}±0.04	2.70^{a}±0.03	0.05425
Gly	5.03^{b}±0.45	4.74^{b}±0.22	4.12^{c}±0.20	5.56^{a}±0.52	2.91^{ef}±0.02	2.72^{f}±0.01	2.95^{ef}±0.05	3.22^{d}±0.1	3.62^{d}±0.18	0.4440
Ala	5.48^{a}±0.44	4.98^{b}±0.25	4.81^{b}±0.20	5.83^{a}±0.55	4.05^{c}±0.22	3.77^{c}±0.08	3.70^{c}±0.14	3.82^{c}±0.11	3.90^{c}±0.19	0.4852
Cys	0.91^{b}±0.00	0.93^{a}±0.00	0.84^{c}±0.00	0.75^{d}±0.00	0.64^{e}±0.00	0.54^{f}±0.01	0.32^{g}±0.01	0.19^{h}±0.00	0.09^{i}±0.00	0.01715
Tyr	6.47^{a}±0.29	6.32^{ab}±0.35	5.95^{ab}±0.36	5.89^{b}±0.31	5.81^{b}±0.51	5.91^{b}±0.32	5.11^{c}±0.23	4.65^{cd}±0.21	4.27^{d}±0.13	0.5532
Arg	1.93^{e}±0.02	3.85^{a}±0.36	3.73^{a}±0.15	3.63^{a}±0.19	2.55^{d}±0.01	3.30^{b}±0.12	2.98^{c}±0.03	2.01^{e}±0.01	1.62^{f}±0.08	0.2602
					Cow colostrum					
Asp	8.57^{a}±0.86	8.81^{a}±0.62	8.55^{a}±0.55	8.66^{a}±0.64	8.77^{a}±0.98	9.53^{a}±0.99	8.92^{a}±1.12	8.56^{a}±0.76	8.20^{a}±0.52	1.385
Ser	11.35^{a}±1.10	11.06^{a}±1.04	10.10^{a}±0.90	7.71^{b}±0.69	7.80^{b}±0.65	7.59^{b}±0.56	6.71^{bc}±0.43	6.16^{c}±0.50	5.61^{c}±0.44	1.271
Glu	12.68^{c}±1.30	13.36^{c}±1.44	15.05^{bc}±1.98	18.16^{ab}±2.52	18.77^{a}±2.80	17.23^{ab}±1.98	18.45^{ab}±1.97	19.54^{a}±2.30	19.81^{a}±2.26	3.619
Pro	0.22^{ef}±0.01	0.26^{cd}±0.00	0.21^{f}±0.00	0.27^{c}±0.00	0.23^{e}±0.01	0.25^{d}±0.04	0.27^{c}±0.04	0.30^{b}±0.01	0.32^{a}±0.01	0.01715
Gly	7.87^{a}±0.51	7.64^{a}±0.38	6.15^{b}±0.50	4.99^{c}±0.20	5.07^{c}±0.30	4.64^{cd}±0.46	4.11^{de}±0.20	3.77^{e}±0.13	3.53^{e}±0.23	0.6016
Ala	5.99^{a}±0.19	6.25^{a}±0.39	6.11^{a}±0.52	5.82^{a}±0.32	6.2^{a}±0.61	6.08^{a}±0.85	5.88^{a}±0.33	4.89^{b}±0.21	3.89^{c}±0.25	0.7196
Cys	0.69^{b}±0.01	0.76^{a}±0.00	0.57^{c}±0.01	0.23^{d}±0.00	0.08^{h}±0.01	0.14^{ef}±0.01	0.15^{e}±0.00	0.13^{f}±0.00	0.11^{g}±0.01	0.01715
Tyr	3.65^{bc}±0.09	3.68^{b}±0.09	3.64^{bc}±0.10	3.09^{d}±0.09	2.51^{e}±0.01	3.45^{c}±0.08	3.20^{d}±0.11	3.71^{b}±0.09	4.22^{a}±0.10	0.2237
Arg	2.91^{a}±0.03	2.59^{b}±0.01	2.59^{b}±0.00	1.86^{f}±0.01	1.95^{d}±0.02	2.10^{c}±0.01	1.91^{e}±0.01	1.91^{e}±0.02	1.93^{d}±0.02	0.01715

Means in the same raw with different superscript letters differ significantly.
SD: Standard deviation of the mean.

Table 3: T-test values of essential amino acids difference between buffaloes and cows colostrum.

Time (h)	Type	Thr	Val	Met	Ile	Leu	Phe	His	Lys
At calving	Buffalo Cow	0.917	0.9906	0.5799	0.1484	0.0217	0.277	0.2751	0.2043
120	Buffalo Cow	0.273	0.0001	0.0955	0.0002	0.0884	0.9571	0.0001	0.3396

Table 4: T-test values of non-essential amino acids difference between buffaloes and cows colostrum

Time (h)	Type	Asp	Ser	Glu	Pro	Gly	Ala	Cys	Tyr	Arg
At calving	Buffalo Cow	0.071	0.0004	0.055	0.000	0.0001	0.009	0.0003	0.0005	0.0001
120	Buffalo Cow	0.285	0.422	0.955	0.0001	0.001	0.003	0.0001	0.0045	0.0235