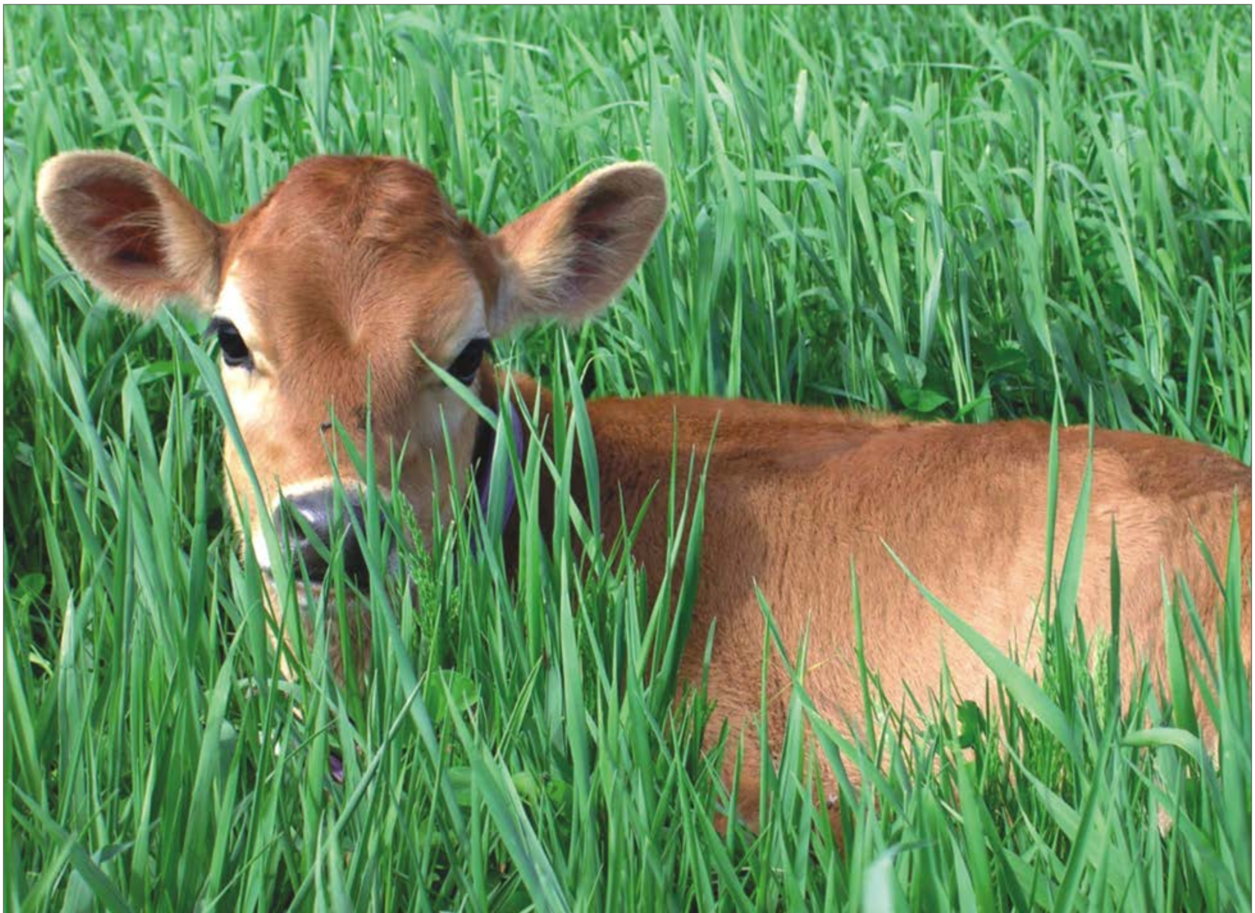

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Changes in Amino Acids Profile of Camel Milk Protein During the Early Lactation

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Abstract: The aim of the present study was to characterize the changes occurring in amino acids profile of camel milk protein during the 1st month of lactation and seek to justify such dynamics of change in relation to the specific needs of growing neonates. Milk samples were collected from camels at varying stages of lactation from the 1st day till 30 day of parturition. Daily samples were tested for fat, protein, lactose, ash and total solids %. The respective mean values at parturition were 0.50±0.06, 12.99±0.20, 2.75±0.40, 0.96±0.037, 20.25±2.50, while at the 30 day the respective mean values were 3.78±0.68, 3.30±0.25, 5.85±0.43. 0.70±0.040, 15.06±1.45. The mean of different amino acid values at the 1st day were significantly increased then sharply decreased in the 3rd day and continuously decreased till reach to the 5th day after that slightly decreased in the 7th day. So, we noticed a non significant decreased in the reminder time, 10, 15, 21 and 30 day, respectively. While there is a significant increase in the level of serum insulin growth factor-1 at zero time and then began to decrease till 30 days. At the same time, concentrations of triiodothyronine and thyroxin were very high at birth and then decreased to relatively low concentrations on day 30. This study demonstrates that camel milk during the 1st month of lactation have important effects on clinical, metabolic and endocrine traits.

Key words: Camel milk, chemical composition, amino acid profile in milk, serum insulin growth factor-I, triiodothyronine and thyroxin

INTRODUCTION

Camel's milk is a major source of protein and energy for desert inhabitants especially for those in the Middle East. Recently camel´s milk has been introduced in local markets in countries of Gulf region. Few investigations have focused on studying the chemical composition and nutritional quality of camel´s milk, Farah (1993) and Zheng *et al*. (2005). Proteins of camel milk contain all essential amino acids and in its fats there are unsaturated aliphatic acids. The amino acid composition of milk declines as lactation advances. The contents of methionine, valine, phenylalanine, arginine and leucine are greater than in cow milk. The nitrogen content of camel milk was found to be 15.6 g/100 g. The following amino acids are present: Alanine 3.05; arginine 3.15; asparagine 7.65; glycine 1.57; glutamine 23.4; histidine 2.5; isoleucine 6.4; leucine 10.4; lysine 7.6; methionine 3.5; phenylalanine 5.7; proline 13.3; serine 5.9; threonine 6.9; tyrosine 5.8; valine 7.4; ammonia 1.72 (Zafar and Shahan, 2004).

Camel colostrum is rich in IgG (Immunoglobulin G) and serum albumin. The main protein in camel colostrum serum is serum albumin while that of bovine colostrum whey islactoglobulin individual camel colostrums (Ibrahim, 1989; Zafar and Shahan, 2004). Colostrum is the exclusive nutrient source for the neonate and the most abundant and well-characterized growth factors in colostrum are probably

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Amino acids and insulin like growth factors I and II (Blum and Baumrucker, 2002). Amino acids are an important source of energy for the growing fetus as well as regulators of embryo development and viability (Bell *et al*., 1989). Furthermore, glutamine plays a major role in fetal nitrogen and carbon metabolism. The vital roles of amino acids in fetal nutrition and metabolism are consistent with our recent findings of the predominance of glutamine in fetal plasma and amniotic fluid and the unusual abundance of arginine and ornithine in the allantoic fluid, Wu *et al*. (1996). Insulin like growth factor-I (IGF-I) is a major form in colostrums and is biologically more potent than IGF-II. IGF-I has a strong anabolic effect on muscle tissue and it is associated with regulatory feed back of growth hormone. IGF-I can mimic most but probably not all effect of growth hormone (Hammon and Blum, 1998; Daughaday and Rotwein, 1989). This hypothesis is supported by the finding that dietary cow colostrum has been shown to increase blood IGF-I concentration in calves. Endocrine factors such as insulin like growth factor and thyroid hormones (Triiodothyronone (T_3) and Thyroxine (T_4) can also influence the time point of gut closure for protein and peptide absorption (Hadron *et al*., 1997; Blum and Hammon, 2000).

The objective of this study was to characterize the changes occurring in amino acids of Camel milk protein and determine the dynamic relation ships among IGF-I, T_3 and T_4 during the 1st month of lactation and seek to justify such dynamics of change in relation to the specific needs of the growing neonates.

MATERIALS AND METHODS

Milk Samples

Milk samples were collected from camels in Marsa Matrouh Farm (Animal Production Institute-Dokki-Egypt) at varying stages of lactation, samples were collected in the morning during winter. Samples (350 mL from each camel) were collected in polyethelyne bottles and kept on ice during transportation to the laboratory where they were stored at 30°C until analyzed.

All camels milk taken during the first 7 day of lactation were considered as colostrums, the reminder (10-30 day) considered as mature milk.

All samples were taken with supervision by manual expression and were collected in sterile containers without preservatives.

Milk Analysis

- Milk samples were analyzed for total protein, fat, lactose, total solids and ash as described by AOAC (1995), while lactose content was measured according International Dairy Federation (IDF) (1974).
- Amino acid was analyzed by precipitating of casein from skimmed milk with 0.01 mol L^{-1} acetic acid at pH 4.5-4.6. The precipitate was washed three times with water and freeze dried. Twenty to thirty milligram of this acid casein were hydrolyzed with 6 mol L^{-1} HCl for 24 h at 110°C under vacuum. The hydrolyze was analyzed on a model liquimat III amino acid analyzer (Kontron Instruments AG, Zurich) according to the procedure of Amado *et al*. (1983).

Blood Samples

Blood samples were individually collected from camels (calves and mature) per treatment and serum samples were separated and kept at a refrigerator until used for analysis.

Hormone Analysis of Serum

Both T_3 and T_4 concentration were estimated with commercially available solid-phase single antibody kits (ImmuChem™ Triiodo thyronine and ImmuChem™ thyroxine, ICN Biomedicals, Irvine, CA). As previously described by Kinsbergen *et al*. (1994). Insulin-like growth factor-I were estimated with radioimmunoassay as previously described by Hammon and Blum (1997).

Statistical Analysis

The results were reported as the mean±Standard Error (SE). Significance of the observed differences was tested at $p \leq 0.05$ probability level. One way ANOVA was performed the least significant of differences among treatments according to the procedure reported by Perrie and Watson (1999).

RESULTS AND DISCUSSION

Gross Composition

Changes in gross composition (protein, lactose, fat, ash and TS) of camel colostrum and milk during the 1st month of lactation period are shown in Table 1. Colostrum is produced for the first week, after which the secretion is considered regular milk (Gorban and Izzeldin, 1997). There was a sharp decline in protein content from 12.99±0.20 in the 1st day, It continued decreasing gradually to reach 5.12±0.65% on day 2 of lactation, stabilized between day 3 to 6 and further decreased to 3.95±0.67, 3.85±0.34 and 3.30±0.25% at day 7, 10 and 30, respectively. A similar trend was observed in Alxa bactrian camel milk, Zheng *et al*. (2005) and Najdi camel colostrum (Abu-Lehia, 1989), where the protein content decreased from 13.00 to 5.12% within the first 24 h and further decreased to 4.02% on day 10 of lactation. Ohri and Joshi (1961) also reported a protein content decreased from 14.49% at the first milking day to 3.95% on day 6 of lactation in Indian camel colostrum. In contrast, Kazakhstan camel colostrum exhibited higher protein content (19.4%) at parturition and then decreased quickly to 3.6% within 2 day (Bestuzheva, 1958). Moreover, the mean protein contents in pooled colostrum (1 to 7 day PP) and regular milk (10 to 240 day PP) of dromedary camels in Saudi Arabia were 5.82 and 3.27%, respectively (Gorban and Izzeldin, 1997), which were almost similar to those of our results. This result may be due to a greater protein accretion in the intestine probably because of Ig absorption and protein synthesis in visceral organs, brain, lung and muscle.

The lactose content was 2.75±0.40% in the 1st day and increased gradually to 4.24±0.15% in the 2nd day and remained relatively stable from 5th day 5.20±0.44% till the 30 day 5.85±0.43 during the study period. The values of the lactose content of Alxa camel milk ranged from 4.24 to 4.44%, whereas for dromedary camel milk, the values ranged from 2.56 to 5.80% (Mehaia *et al*., 1995; Gordan and Izzeldin, 1997). It is well known that bovine colostrum is also rich in most of its components such as protein, fat, serum proteins and ash, the only component that is low in bovine colostrum in the first

Table 1: Major components of camel colostrum and mature milk

Days	Protein (%)	Lactose (%)	Fat (%)	Ash (%)	TS (%)
1st	12.99±0.20***	2.75±0.40**	0.50±0.06***	0.96±0.037**	20.25±2.50***
2nd	5.12±0.65	4.24±0.15	1.27±0.45	0.85±0.025	13.95±0.36
3rd	4.25±0.82	4.35±0.27	1.60±0.65	0.83±0.027	13.17±0.72
4th	4.15±0.65	4.95±0.52	1.73±0.80	0.79±0.039	12.50±1.11
5th	4.08±0.55	5.20±0.44	2.28±0.75	0.77±0.035	12.35±0.95
6th	3.95±0.42	5.45±0.50	2.80±0.65	0.75±0.027	13.10±0.90
7th	3.95±0.67	5.70±0.42	3.09±0.63	0.75±0.025	13.90±0.85
10th	3.85±0.34	5.82±0.35	3.28±0.50	0.74±0.029	14.22±0.77
15th	3.60±0.60	5.83±0.24	3.30±0.61	0.72±0.025	14.75±1.45
21st	3.47±0.35	5.83±0.16	3.65±0.50	0.72±0.039	15.05±1.11
30th	3.30±0.25	5.85±0.43	3.78±0.68	0.70±0.040	15.06±1.45
LSD between time	0.45	0.15	0.38	0.06	2.25

***: Highly significant; **: Moderate significant days after parturition and increases subsequently is lactose (Merin *et al*., 2001). The same was reported for camel milk (Yagil and Etzion, 1980; Abu-Lehia, 1991), but was not confirmed in the study by Merin *et al*. (2001), possibly due to the determination of lactose by difference.

The fat content of camel colostrum at 1st day after parturition was as low as 0.50%, which was similar to Kazakhstan camel (Bestuzheva, 1958) and Najdi camel (Abu-Lehia *et al*., 1989). Its content significantly increased to 1.27% within the first 48 h, peaked at 3.78% after 1 month. A similar trend was noted for dromedary camel milk as reported by Merin *et al*. (2001), where the fat content of colostrum initially was low, then reached its highest levels after about a week and then decreased to its average value thereafter. This pattern was in contrast to those of the bovine, sheep and goat colostrum (Abu-Lehia *et al*., 1989). It can be theorized that in camels the low fat content of colostrums immediately after parturition is due to the camel ability of physiological fluctuations of body temperature by 6°C, reducing the need in calories immediately after birth (Yagil, 1985). In addition, the suckling of camels takes place every half an hour, so the caloric requirements are met in total (Merin *et al*., 2001).

At 2 h after parturition, the ash content of camel colostrum was 0.96%. This was higher than that of Jordanian (0.57%) and similar to Najdi (0.99%) camels and lower than that of Indian (2.6%) and Kazakhstan (3.8%) camel colostrum as reported by Yagil and Etzion (1980), Abu-Lehia *et al*. (1989), Ohri and Joshi (1961) and Bestuzheva (1964), respectively. The ash content decreased significantly to 0.96% in the first 12 h and then fluctuated slightly thereafter with percentages ranging from 0.85 to 0.70%. In contrast, a steady decrease in ash content of colostrum was reported for the Najdi camel, Abu-Lehia (1989). Ash content ranged from 0.6 to 1.0% for dromedary camels (Mehaia *et al*., 1995; Gordban and Izzeldin, 1997; Guliye *et al*., 2000), suggesting that camel milk may provide a satisfactory level of minerals for consumers (El-Amin and Wilcox, 1992).

The TS content of colostrum showed a rapid decrease from 20.25 to 13.95% during the first 12 h, likely attributed to the sharp decrease in the protein content over the same period. The TS content remained relatively stable (13.95 in the 2nd day to 13.90% in the 7th day), however, slightly increased from 14.22% on day10th till 15.06% in the 30 days of lactation. Bestuzheva (1964) and Abu-Lehia (1989) also reported a sharp decrease in TS content in colostrum during the 1st days of lactation for Kazakhstan and Najdi camels. According to Mehaia *et al*. (1995), the TS content ranged from 10.0 to 14.4% in dromedary camel milk. This decrease in the TS content may be attributed mainly to the decrease in the protein content over the same period. This increase in TS was obviously may be due to the gradual increase in the content of lactose and fat.

The contents of protein, lactose, fat, ash and TS of camel milk at 30 day PP were 3.30, 5.85, 3.78, 0.70 and 15.06, respectively (Table 2). Under the same conditions, the chemical composition of camel milk varies from species to species (Mehaia *et al*., 1995; Gaili *et al*., 2000) and the largest variations during lactation were in TS and fat contents. Gaili *et al*. (2000) showed that the stage of lactation did not significantly affect the constituents in regular camel milk. According to Alhadrami (2003), the composition of camel milk is similar to bovine milk and the average values of protein, lactose, fat, ash and TS contents of camel milk were 3.4, 3.7, 4.1, 0.7 and 13.1%, respectively.

Regarding to the differences between mature Camel, Cow and Goat milk, Table 3, which revealed a non significant changes between the various species in the fat, protein, lactose and ash content except in TS there are a significant difference between the three animals, it was 15.06, 11.95 and 8.90% in

Table 2: Comparison between mature camel, cow and goat milk

Animals	Fat (%)	Protein (%)	Lactose (%)	Ash (%)	(T.S.%)
Camel	3.78±0.68ns	3.3±0.25ns	5.85±0.43ns	0.70±.040ns	15.06±1.45***
Cow	4.01±0.29ns	3.2±0.36ns	5.05±0.75ns	0.68±0.025ns	11.95±1.50***
Goat	4.30±0.25ns	3.5±0.31ns	3.50±0.31ns	0.75±0.35ns	8.90±1.65***
LSD	0.55	0.3	1.85	0.09	1.95

***: Highly significant; ns: Not Significant

Table 3: Amino Acids composition of camel colostrum and mature milk

Time AA	1st day	3rd day	5th day	7th day	LSD
Aspartic acid	10.249±1.249***	8.008±0.780	7.677±0.915	7.325±0.652	0.395
Glutamicacid	26.946±2.156***	21.944±2.250	19.630±1.973	19.125±1.825	1.050
Serine	8.408±0.673***	6.394±0.525	5.380±0.638	5.105±0.520	0.655
Glycine	4.764±0.45***	3.689±0.370	2.850±0.325	2.650±0.275	0.180
Histidine	4.796±0.35***	3.638±0.357	3.080±0.350	2.820±0.285	0.200
Arginine	5.980±0.485***	3.721±0.365	2.7850±0.325	2.520±0.260	0.240
Threonine	7.995±0.775***	6.124±0.625	5.4730±0.643	5.125±0.525	0.320
Alanine	5.007±0.531***	3.617±0.370	2.754±0.315	2.325±0.252	0.360
Proline	18.090±1.75***	15.943±1.575	13.478±1.540	13.150±1.415	0.510
Tyrosine	7.364±0.687***	5.579±0.570	4.940±0.485	4.530±0.460	0.300
Valine	8.109±0.815***	6.310±0.775	5.889±0.472	5.273±0.620	0.430
Methionine	4.792±0.45***	3.482±0.435	2.443±0.250	2.125±0.235	0.210
Cysteine	4.944±0.475***	3.824±0.375	2.842±0.293	2.530±0.260	0.200
Lysine	7.646±0.75***	5.845±0.625	4.565±0.415	4.420±0.345	0.090
Isoleucine	7.935±0.825***	6.316±0.750	5.988±0.575	5.335±0.550	0.450
Leucine	11.772±1.25***	8.685±0.965	7.444±0.655	7.215±0.725	0.220
Phenyl alanine	6.023±0.575***	4.852±0.565	4.557±0.470	4.125±0.415	0.330

Time AA	10th day	15th day	21 day	30 day	LSD
Aspartic acid	7.124±0.625	7.095±0.695	7.055±0.810	6.930±0.670	0.395
Glutamicacid	18.525±1.925	18.326±1.930	18.125±1.925	18.095±1.920	1.050
Serine	4.750±0.485	4.520±0.462	4.315±0.451	4.250±0.395	0.655
Glycine	2.215±0.235	2.105±0.215	2.075±0.217	2.050±0.215	0.180
Histidine	2.420±0.245	2.150±0.224	2.090±0.225	2.063±0.222	0.200
Arginine	2.150±0.225	2.065±0.217	2.013±0.250	1.975±0.210	0.240
Threonine	4.920±0.395	4.650±0.475	4.220±0.512	4.075±0.417	0.320
Alanine	2.290±0.250	2.175±0.227	2.090±0.215	2.050±0.215	0.360
Proline	12.750±1.370	12.560±1.350	12.135±1.335	11.970±1.250	0.510
Tyrosine	3.720±0.380	3.530±0.350	3.325±0.372	3.115±0.315	0.300
Valine	4.825±0.482	4.530±0.453	4.275±0.427	4.125±0.390	0.430
Methionine	2.075±0.217	2.050±0.215	2.015±0.215	1.980±0.240	0.210
Cysteine	2.095±0.221	2.070±0.217	2.035±0.223	1.935±0.225	0.200
Lysine	4.115±0.415	4.085±0.399	4.040±0.415	3.960±0.415	0.090
Isoleucine	5.113±0.515	5.105±0.515	5.095±0.518	4.875±0.516	0.450
Leucine	6.950±0.685	6.725±0.692	6.350±0.645	6.125±0.625	0.220
Phenyl alanine	4.070±0.417	4.025±0.425	4.011±0.412	3.950±0.420	0.330

***: Highly significant between times

camel, cow, goat, respectively. The results agree with Gaili *et al.* (2000), They revealed that the chemical composition of camel milk varies from species and the largest variations during lactation were in total solid and fat contents. But, Alhadrami (2003), show that a composition of camel milk is similar to bovine milk and the average value of protein, lactose, fat, ash and TS continuity of camel milk were 3.4, 3.7, 4.1,0.7 and 13.1%, respectively.

Amino Acid Composition

Table 3, show the amino acid composition of camel milk through different times. The mean of different amino acid values at the 1st day were significantly increased then sharply decreased in the 3rd day and continuously decreased till reach to the 7th day. So, we noticed a non significant change in the reminder time, 10th, 15th, 21 and 30 day, respectively, this result may be due to the sharp decline in the mean value of protein content where the total milk protein yield was defined as a function of individual amino acid supply (Doepel *et al.*, 2004). Ontsouka *et al.* (2003) show that protein in colostrums is utilized by the neonate for protein synthesis in addition to the absorption of Ig and stimulation of protein metabolism after calving requires large amounts of amino acids. Also, Newborn that were fed colostrums had greater amino acids accretion in the intestine (probably because of Ig absorbtion) and protein synthesis in visceral organs, brain, lung and muscle (Farah and Ruegg, 1989). Glutamic acid is increased in neonate because it play a major role in fetal nitrogen and carbon

Table 4: The difference between amino acids composition of the milk of mature camel, cow and goat

Amino acids	Camel	Cow	Goat	LSD
Aspartic acid	6.930	6.2-7.8	7.40	0.50^{ns}
Glutamic acid	18.095	15.8-23.2	19.30	1.85^{ns}
Serine	4.250	6.60	5.20	0.73***
Glycine	2.050	0.8-2.1	2.10	0.06^{ns}
Histidine	2.063	3.0	5.00	0.69***
Arginine	1.975	2.9-4.2	2.85	0.93***
Threonine	4.075	5.80	5.70	0.83***
Alanine	2.050	4.15	3.60	1.05***
Proline	11.970	10.1-11.8	14.60	1.75***
Tyrosine	3.115	5.80	4.80	1.25***
Valine	4.125	7.50	5.70	0.84***
Methionine	1.980	3.20	3.50	1.83***
Cysteine	1.935	0.65	0.55	0.35***
Lysine	3.960	8.10	8.20	2.90***
Isoleucine	4.875	4.1-6.2	7.10	0.95***
Leucine	6.125	5.2-8.3	8.20	0.87***
Phenyl alanine	3.950	5.40	6.00	1.55***

ns = Non significant; ***: Highly significant

metabolism and help in development of placenta and fetal growth (Korhonen *et al*., 2002). While glycine show a high experimental efficiency of utilization and is required to tissue growth and for a number of physiologic processes such as the synthesis of nucleic acids bile acids hemoglobin and glutathione. Arginine showed the highest efficiency of utilization for maximum growth in growing faetus. Threonine, leucine, isoleucine, tyrosine and phenylalanine in particular were increased at the expense of glycine, alanine, praline, this indicates an increase in the ratio between muscle and collagen protein with faster growing animals. Increasing protein-free energy generally increased the proportion of protein deposited in the carcass, this could explain the effects of protein free energy intake on the content of aspartic and glutamic acid, glycine and isoleucine and praline (Walter *et al*., 1998).

Table 4 present the difference between the estimated amino acid of camel milk and the other milk such as cow and goat. This table deal that aspartic acid, glutamic acid and glycine value in camel milk in the same range like that in cow and goat, serine in camel milk significantly lower than that of cow and goat, histidine, arginine, threonine, alanine, tyrosine, valine, methionine, lysine,isoleucine, leucine, Phenylalanine significantly lower in camel than that of cow and goat milk, proline value of camel milk is the same with cow milk but lower than that of goats milk, cysteine value in camel milk was significantly higher than that of cow and goat milk but isoleucine was lower in camel milk than in goat´s milk, this result disagree with Landis (2004), who revealed that the overall amino acid composition is similar in all three and all three have satisfactory balance of essential amino acids equaling or exceeding the FAO-WHO requirements for each amino acid.

Serum Insulin Growth Factor-I Hormone

Regarding to the values of IGF-I hormone, Table 5, revealed a significant increase in the level of serum IGF-I at zero time in the neonate (616.881±62.520) and mother's serum animals (655.330±62.333) then a sharp decline in the 1st day (454.820±42.802) in neonate and (550.352±52.331) in mother's serum and a further decreased in the 5, 7, 10, 15 and 21 days and reach to (175.790±16.720) in neonates and (203.011±18.352) in mature she-camel after 1 month. Michanek *et al*. (1989) show that a more marked rise in IGF-I levels on day 1 in calves fed colostrum instead of mature milk may lead to the conclusion that colostrum-borne IGF-I was absorbed by our neonatal calves. The sluggish rise of IGF-I in the 1st day of parturition and the fall of IGF-I levels during the 30 day in this study probably mirrored increased and decreased endogenous production. Furthermore, GH enhances IGF-I production only slightly in the neonatal calf (Breier *et al*., 1988; Hammon and Blum, 1997). IGF-I poduction was possibly enhanced by nutrient factors,

Table 5: Values of Serum Insulin growth factor-I (IGF-I), Triiodothyronine (T_3) and Thyroxin (T_4) through the 1st month of lactation

	IGF-I (ng dL^{-1})		T_3 (ng dL^{-1})		T_4 (ng dL^{-1})	
Days	Neonate	Mother	Neonate	Mother	Neonate	Mother
0	616.881±62.520	655.330±62.333	500.000±48.250	512.511±50.430	38.678±3.550	38.717±3.547
1	454.820±42.802	550.352±52.331	381.787±35.220	394.662±35.644	38.279±3.452	38.412±3.850
5	400.039±38.541	463.301±44.505	355.543±32.540	361.162±34.250	36.787±3.450	37.753±3.650
7	394.863±36.540	400.039±38.120	331.145±30.145	335.252±30.524	35.659±2.987	36.094±3.500
10	339.550±30.420	354.162±33.421	263.643±24.361	270.147±25.410	35.500±3.544	35.109±3.420
15	279.455±25.312	281.030±28.123	197.499±17.425	207.154±18.245	34.500±3.441	24.372±2.410
21	240.240±22.544	252.772±25.224	187.153±16.280	190.431±17.335	33.334±3.325	32.090±3.120
30	175.790±16.720***	203.011±18.352***	165.250±14.523***	170.431±15.430***	31.759±3.087***	30.105±2.564***

***: Highly significant decrease from 0 time till 30 day of age

especially fatty acids and amino acids which increased in colostrum. IGF binding protein patterns, hence metabolic clearance rates of IGF-I, can be altered by nutrition in neonatal calves (Hammon and Blum, 1997).

Serum Thyroid Hormone

Table 5, shows a significant decrease in triiodothyronin (T_3) from 0 time until 1month, at 0 time, it was (500.000±48.250) in neonate and (512.511±50.430) in mother's serum then, a sharp decline occur to (165.250±14.523) in neonate and (170.431±15.430) in mother's serum after 1 month. While, a significant decrease in the level of thyroxin hormone (T_4), from 0, (38.678±3.550) in neonate and (38.717±3.547) in mother's serum and decreased relatively to (31.759±3.087) in neonate and (30.105±2.564) in mother's serum, after 1 month. Kinsbergen *et al*. (1994) and Grongnet *et al*. (1985) agree with present results and conclude that thyroid hormones are important for the maturation of small intestinal function.

CONCLUSIONS

The present study shows the composition of camel milk for 1 month following parturition. Camel colostrums is poor in lactose and fat in the first day and increased gradually till reach the maximum after 1 month. On the contrary, camel colostrums is reach in protein and total solids at 1st day and gradually decreased till reach 30 day. Study conclude that the chemical composition of camel milk varies from species and the largest variations during lactation were in total solid. There are a fluctuation in the amino acids in the first 7 days, this may be due to sharp decline in the mean value of protein content. Also, the study show differences between the composition of amino acids in camels and other animals. Serum IGF-I, T_3 and T_4 were increase in zero time then sharply decreased at 30 day.

Although it is well documented that early camel milk during the 1st month of lactation is important for passive immunity, this study demonstrates additionally that camel milk during the 1st month of lactation have important effects on clinical, metabolic and endocrine traits.

REFERENCES

Abu-Lehia, I.H., 1989. Physical and chemical characteristics of camel milk fat and its fractions. Food Chem., 34: 261-272.

Abu-Lehia, I.H., 1991. Nitrogen distribution and mineral contents of camel colostrums. Aust. J. Dairy Technol., 46: 82-84.

Alhadrami, G.A., 2003. Camel in Encyclopedia Odd Airing Science. Roginski, H., J.W. Fuquay and P.F. Fox (Eds.), Academic Press, London, pp: 616-622.

Amado, R., E. Rothenbulher, E. Arrigoui and J. Solms, 1983. Abbau Von Purinderivaten Zu Glycin durch saure Hydrolyse. Mitt Gebiete Lebensm-Hyg., 74: 23-30.

AOAC., Association of Official Analytical Chemists, 1990. Association of Official Analytical Chemists. Official Methods of Analysis. 13th Edn., Assoc. Offic. Anal. Chem., Washington, DC., USA.

Bell, A.W., J.M. Kennaugh, F.C. Battaglia and G. Meschia, 1989. Uptake of amino acids and ammonia at mid gestation by the fetal lamb. Q. J. Exp. Physiol., 74: 635-643.

Bestuzheva, K.T., 1958. Composition of the colostrums and milk of camels. Dairy Sci. Abstr., 20: Abstr. No. 2937.

Bestuzheva, K.T., 1964. Chemical composition of camel milk and colostrum. Konevodstvoi Konnyi Sport., 34: 19.

Blum, J.W. and H.M. Hammon, 2000. Colostrum effects on the gastrointestinal tract and on nutritional, endocrine and metabolic parameters in neonatal calves. Livest. Prod. Sci., 66: 151-159.

Blum, J.W. and C.R. Baumrucker, 2002. Colostral insulin-like growth factors and related substances: Mammary gland and neonatal (intestinal and systemic) targets. Domest. Anim. Endocrinol., 23: 101-110.

Breier, B.H., P.D. Gluckman and J.J. Bass, 1988. Plasma concentrations of insulin-like growth factor I and insulin in the infant calf: Ontogeny and influence of altered nutrition. J. Endocrinol., 119: 43-50.

Daughaday, W.H. and P. Rotwein, 1989. Insulin-like growth factors I and II. Peptide, messenger ribonucleic acid and gene structures, serum and tissue concentrations. Endocr. Rev., 10: 68-91.

Deopel, L., D. Pacheco, J.J. Kennelly, M.D. Hanigan, I.F. Lopez and H. Lapierre, 2004. Milk protein synthesis as a function of amino acid supply. J. Dairy Sci., 87: 1279-1297.

El-Amin, F.M. and C.J. Wilcox, 1992. Milk composition of Majaheim camels. J. Dairy Sci., 75: 3155-3157.

Farah, Z. and M.W. Ruegg, 1989. The size distribution of casein micelles in camel milk. Food Microstructure, 8: 211-212.

Farah, H., 1993. Composition and characteristics of camel milk. J. Dairy Sci., 60: 603-626.

Gaili, E.S.E., M.M. Al-Fknah and M.H. Sadek, 2000. Comparative milking performance of three types of saudi camels (*Camels dromedarius*). J. Camel Pract. Res., 7: 73-76.

Gordan, A.M.S. and O.M. Izzeldin, 1997. Mineral content of camel milk and colostrums. J. Dairy Res., 64: 471-474.

Grongnet, J.F., E. Grongnet-Pinchon and Witowski, 1985. Neonatal levels of plasma thyroxine in male and female calves fed a colostrum or immunoglobulin diet or fasted for the first 28 h of life. Reprod. Nutr. Dev., 25: 537-543.

Guliye, A.Y., R. Yagil and F.D.D. Hovell, 2000. Milk composition of Bedouin camels under semi-nomadic production system. J. Camel Pract. Res., 7: 209-212.

Hadorn, U., H. Hammon, R.M. Bruckmaier and J.W. Blum, 1997. Delaying colostrum intake by one day has important effects on metabolic traits and on gastrointestinal and metabolic hormones in neonatal calves. J. Nutr., 127: 2011-2023.

Hammon, H.M. and J.W. Blum, 1997. The somatotropic axis in neonatal calves can be modulated by nutrition, growth hormone and Long-R^3-IGF-I. Am. J. Physiol., 273: E130-E138.

Hammon, H.M. and J.W. Blum, 1998. Metabolic and endocrine traits of neonatal calves are influenced by feeding colostrums for different durations or only milk replacer. J. Nutr., 128: 624.

Ibrahim, H., Abu-Lehia, Ibrahim S. Al-Mohizea and M. El-Beheri, 1989. Physical and chemical characteristics of camel colostrum. Aust. J. Dairy Technol., pp: 34-36.

International Dairy Federation (IDF), 1974. Determination of the Lactose Content of Milk and Milk Production. In: Methods and Analysis Milk and Milk Production. Moscow, Keles.

Kinsbergen, M., H.P. Sallmann and J.W. Blum, 1994. Metabolic, endocrine and hematological changes in 1-week old calves after milk intake, in response to fasting and during total parenteral nutrition. J. Vet. Med. A, 41: 268-282.

Korhonen, M., A. Vanhatalo and P. Huhtanen, 2002. Evaluation of isoleucine, leucine and valine as a second-limiting amino-acid for milk production in dairy cows fed grass silage diet. J. Dairy Sci., 85: 1533-1545.

Landis, C., 2001. Milk from camels, goats and sheep: A Review Institute of Biology. Biologist, 48: 268-272.

Mehaia, A.M., A.H. Mohamed, M.A. Kamal and A.E. Samy, 1995. Milk composition of Majaheim, Wadah and Hamra camels in Saudi Arabia. Food Chem., 52: 115-122.

Merin, U., S. Bernstein, Van C.P. Creveld, R. Yagil and N. Gollop, 2001. Camel (*Camelus dromedarius*) colostrum and milk composition during the lactation. Milchwissenschaft, 56: 2001.

Michanek, P., M. Ventorp and B. Weström, 1989. Intestinal transmission of macromolecules in newborn dairy calves of different ages at first feeding. Res. Vet. Sci., 46: 375-379.

Ohri, S.P. and B.K. Joshi, 1961. Composition of camel milk. Indian Vet. J., 38: 604-608.

Ontsouka, C.E., R.M. Bruckmaier and J.W. Blum, 2003. Fractionized milk composition during removal of colostrum and mature milk. J. Dairy Sci., 86: 2005-2011.

Perrie, A. and P. Watson, 1999. Statistics for Veterinary and Animal Science. 1st Edn., The Blackwell Science Ltd., United Kingdom.

Walter, J.J., Gerrits, J.W. Schrama and S. Tamminga, 1998. The marginal efficiency of utilization of all ileal digestible indispensable amino acids for protein gain is lower than 30% in preruminant calves between 80 and 240 kg live weight. J. Nutr., 128: 1774-1785.

Wu, G., F.W. Bazer, W. Tuo and S.P. Flynn, 1996. Unusual abundance of arginine and ornithine in porcine allantoic fluid. Biol. Reprod., 54: 1261-1265.

Yagil, R. and Z. Etzion, 1980. Effects of drought conditions on the quality of camel milk. J. Dairy Res., 47: 159-166.

Yagil, R., 1985. The Desert Camel Compo Native Physiological Adaptation. In: Comparative Animal Nutrition. Vol. 5. Basel, Switzerland, Karger.

Zafar, I.C. and A. Shaham, 2004. Is camel milk good for human health? An article from Sci-Tech. World, DAWN group. http//:epaper.dawn.com. October 9, 2004.

Zheng, H., J. Yao, D. Zhao, H. Liu, J. Li and M. Guo, 2005. Changes in chemical composition of Alxa bactrian camel milk during lactation. J. Dairy Sci., 88: 3402-3410.