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COMPARATIVE STUDY ON SOME CHEMICAL - PHYSICAL INDICATORS IN COLOSTRUM OF EGYPTIAN BUFFALOES' AND COWS'

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ABSTRACT

This Study was carried out to evaluate the changes in composition, heat stability and quality characteristics of Egyptian buffaloes' and cows' colostrum collected at calving, 4, 12, 24, 48, 72h and after 336h (14 days) of parturition. Total solids, total protein, whey proteins, fat, lactose and ash contents, some elements, vitamins (A and E) were determined. Heat stability, titrable acidity, pH value, specific gravity and viscosity were also estimated.

Total protein and whey proteins concentration were higher in cow than in buffalo colostrum, while total solids, fat, lactose and ash concentrations were higher in buffalo than in cow colostrum. All components decreased gradually as the transition period advanced except lactose which conversely increased. After 72h post-partum, concentration of total protein, whey proteins, fat, ash and total solids decreased by 47.2,72.2, 29.9, 30.0 and 28.9% for buffalo and by 45.1, 73.2, 31.5, 16.4 and 33.0% for cow colostrum. However, lactose concentration increased by 60.0% for buffalo and 68.4% for cow colostrum. The elements concentration of both colostrums tended to decline slightly toward normality on the 14th day of parturition. Buffalo colostrum had a higher concentration of vitamin E than cow colostrum while, cow colostrum had a higher concentration of vitamin A in buffalo colostrum after 4h of partupition. The heat stability of buffalo and cow colostrums after 4h postpartum milk was 5.5 and 7.0 min respectively, and gradually increased in consequent milking i.e. 12h (8.7and 12.0 min), 24h (15 and 20 min), 48h. (24 and 29), and 72h. (30 and 41min), respectively. No coagulation/precipitation was occurred in 14th days postpartum milk. Average acidity, pH, specific gravity and viscosity of buffalo and cow colostrum after 4h. postpartum milk was (0.39 and 0.33%), (6.3 and 6.35), (1.06 and 1.05), (5.8 and 5.05 cP) respectively, and significantly declined to (0.17 and 0.16%), (6.6 and 6.7), (1.o34 and 1.032) and (1.10 and 1.02cP), respectively in 14th day postpartum milk.

Therefore, the study recommends the need to address both bovine or buffalo colostrum during the first 72hours of birth and that of high nutritional value.

INTRODUCTION

Colostrum is vital food for the newborn of all mammals within the first 5-7 days after parturition. It contains various nutrients (protein, fat, carbohydrate, water- and fat-soluble vitamins and minerals) as well as many biologically active substances such as immunoglobulins, antimicrobial factors, growth factors and others (Strekozov *et al*., 2008). Postpartum milk (colostrum) is unsuitable and unprocessable milk which differs considerably in composition and properties from normal milk (Johnson, 1978; Walstra and Jennes, 1984). During transition from colostrum to normal milk gradual or some times sudden changes may occur in composition and properties. Knowing the composition and physical properties of colostrum and post-colostrum secretions will help establish when such milk is suitable for

processing and determine the best use for that milk (Tsioulpas *et al*., 2007). The colostrum composition and its quality are influenced by a variety of factors, including maternal age, parity, breed, nutritional status, season, premature parturition, premature lactation, colostral handling factors (pooling colostrum and storage temperature), induction of parturition and health status (Zarcula *et al.,* 2010). Because colostrum is very important to the newborn, producers must often make provision to have a source of colostrum available if and when the dam does not provide enough high quality colostrum for the calf. In addition, numerous studies suggest that oral administration of bovine colostrum preparations may contribute to human health care both as part of a health promoting diet and as an alternative or supplement to the medical treatment of specified human diseases (Alexieva *et al.,* 2004). Several studies have evaluated the changes in the chemical composition of cow colostrum after parturition, but there is not available information about buffalo colostrum which represents approximately 49% (Mal, 2008) of lactating ruminants in Egypt. So, the aim of this study was to follow the changes in colostrum composition heat stability and quality characteristics of Egyptian buffaloes' and cows' postpartum milk.

MATERIALS AND METHODS

Colostrum samples from 20 freshly calved buffaloes and cows maintained at local farm were collected during the winter seasons of 2012. All samples were analyzed at caving, 4, 12, 24, 48 and 72 hours and after 14 days of parturition. Each sample was obtained in a sterilized sample bottle, of which 10ml was heated (at boiling temperature) to observe length of time for coagulation / precipitation. The rest of the quantity of the sample was used to analyze the physico-chemical characteristics. The acidity, specific gravity, viscosity, total solids, ash and lactose were analyzed according to the method of Association of Official Analytical Chemists (AOAC, 2000) while total or whey protein and fat as described by British Standards Institution (BSI, 1990) and Ling (1963), respectively. pH values were measured according to Ling (1963) using digital pH meter type HANNA instrumenting (8417). Calcium (Ca), Mg, K, Cu, Zn were estimated by inductively coupled plasma atomic emission spectrometry (ICP-AES);Thermo Scientific. Phosphorus was determined colorimetrically according to El-Merzabani *et al.* (1997). Vitamin A was determined according to Omeh and Uzoegwe (2010). Vitamin E was colorimetrically estimated by the method of Nasar *et al*. (2009). All the obtained data were statistically analyzed by SPSS computer software.

RESULTS AND DISCUSSION

Changes in total protein, whey protein, fat and total solids concentration of buffalo and cow colostrum in the first three days and after 14 days of parturition are present in table (1). The total protein, whey protein, fat and total solids concentrations of buffalo colostrum after 4h of parturition were 11.93±0.55%, 11.00±0.60%, 9.70±0.50 and 25.20±0.60% as well as the cow colostrum were 12.57±0.60%, 11.20±0.40%,7.30±0.50 and 22.70±0.60%

respectively. It rapidly decreased in buffalo colostrum after 72h of parturition to 6.3, 3.0, 6.8, 3.0, 5.0 and 15.2% for bovine colostrum, respectively. Generally buffalo and cow colostrum become relatively normal up to 72h postpartum milking, whilst 5 to 6 days had been reported the transition period by different workers (Prasad, 1997). These results were in accordance with those reported by Kehoeetal,(2007), Mechor *et al*, (1992) and Wronski & Sosnowska (2006) for bovine colostrum and Nawer, (2007) and Alaa *et al.,* (2012) for buffalo colostrum.

Table (1): changes in chemical composition (%) of buffalo (B) and cow (C) colostrum during its transition to normal milk

Time (h)	protein		Whey protein		Fat		Ash		Lactose		Total solids	
	B	C	B	C	B	C	B	C	B	C	B	C
4	11.93 ±0.55 a	12.57 ±0.60 a	11.00 ±0.60 a	11.20 ±0.40 a	9.70 ±0.50 a	7.30 ±0.50 a	1.10 ±0.05 a	0.91 ±0.06 a	2.50 ±0.60 c	1.90 ±0.60 c	25.20 ±0.60 a	22.70 ±0.60 a
12	9.17 ±0.55 b	11.00 ±0.50 ab	7.83 ±0.76 b	8.50 ±0.50 b	10.00 ±0.60 a	6.30 ±0.60 ab	1.05 ±0.06 ab	0.87 ±0.05 ab	2.70 ±0.50 c	2.00 ±0.50 c	23.10 ±0.50 b	20.20 ±0.50 b
24	8.43 ±0.55 b	10.13 ±0.55 abc	6.00 ±0.60 c	7.00 ±0.70 c	8.30 ±0.50 b**	6.00 ±0.50 bc**	0.92 ±0.07 b	0.85 ±0.07 ab	3.20 ±0.60 bc	2.30 ±0.60 bc	20.80 ±0.40 c	19.30 ±0.40 b
48	8.23 ±0.45 b	8.40 ±0.50 bc*	4.90 ±0.60 d	5.00 ±0.50 d	7.20 ±0.70 c	5.30 ±0.70 bc**	0.86 ±0.06 bc	0.86 ±0.06 ab	3.50 ±0.50 abc	2.70 ±0.50 bc	19.80 ±0.50 d	17.30 ±0.50 c
72	6.30 ±0.50 c	6.90 ±0.81 c*	3.00 ±0.60 e	3.00 ±0.60 e	6.80 ±0.50 c	5.00 ±0.50 cd	0.77 ±0.06 cd	0.76 ±0.06 bc	4.00 ±0.60 ab	3.20 ±0.60 b	17.90 ±0.60 e	15.20 ±0.60 d
336	3.40 ±0.60 d	3.10 ±0.60 d	0.50 ±0.40 f	0.50 ±0.40 f	6.30 ±0.60 c	4.00 ±0.60 d	0.72 ±0.05 d	0.72 ±0.05 c	4.40 ±0.60 a	4.50 ±0.60 a	14.80 ±0.50 f	12.30 ±0.50 e

Means in the same column or row of each element with different superscript letters significantly

Total protein content of first milking buffalo and cow colostrum were observed very high, which could be due to high concentration of globulin than serve as the carrier of antibodies for suckling calf against disease producing organism (Niekerzon, 1995). Also, the great differences in the total solids content of colostrum contrast to normal milk could be the result of elevated content of antibodies of colostrum (Niekerzon, 1995).

As shown in Table (1) the first buffalo and caw colostrum had ash percentages of 1.10±0.05 and 0.91±0.06% respectively, which was similar to that reported by Alaa *et al*., (2012). At 12h postpartum, the ash concentration decreased significantly from buffalo (1.05±0.06%) and cow (0.87±0.05%) colostrum. The ash concentration of both colostrums continued to decrease reaching a value of 0.72±0.05%.

Lactose content of buffalo and cow colostrum at 4h postpartum milking were observed as 2.5±0.60% - 1.90±0.60% respectively. The concentration level of lactose in the present study was lower than the values of normal buffalo or bovine milk different works (Prasad, 1997 and Chaudhry, 2002).

Lactose concentration increased until the third day of parturition. On the 14th day postpartum, lactose concentration of buffalo and cow milk was 4.40±0.60% and 4.50±0.60% respectively, which was similar to that of the normal milk (Table1).

Changes in some elements concentration in buffalo and cow colostrum during 72 h and after 14 days of parturition are showen in table (2). At 4h postpartum cow colostrum had higher concentration of Mg, K, Cu and Zn and lower concentration of Ca and p than buffalo colostrum. All minerals concentration decreased gradually toward normality after three days of parturition. Similar results were reported by Alaa *et al*., (2012), but the opposite trend with regards to K was found by Toshiyoshi *et al*., (2003) for cow colostrum. While, Tsioulpas *et al*., (2002) didn't find remarkable change between the initial and final K concentration of bovine colostrum.

Table (2): Changes in minerals content (mg/100g) of buffalo and cow colostrum uring its transition to normal milk.

Time (h)	Ca		Mg		K		P		Cu		Zn	
	B	C	B	C	B	C	B	C	B	C	B	C
4	279.10 ±2.10^{a}	284 ±3.10^{b}	33.20 ±1.0^{a}	37.10 ±0.80^{a}	105.40 ±1.70^{a}	171.30 ±1.80^{a}	56.30 ±0.80^{b}	50.80 ±0.90^{e}	0.12 ±0.04^{a}	0.12 ±0.04^{b}	0.21 ±0.0^{b}	0.22 ±0.02^{a}
12	270.20 ±1.80^{b}	296.10 ±3.90^{a}	29.70 ±1.20^{b}	26.40 ±0.50^{c}	101.20 ±1.60^{c}	160.20 ±1.00^{b}	54.30 ±0.50^{c}	57.70 ±1.20^{a}	0.09 ±0.02^{b}	0.178 ±0.01^{c}	0.219 ±0.02^{a}	0.22 ±0.01^{b}
24	261.40 ±1.80^{c}	245.20 ±2.00^{c}	29.10 ±0.90^{c}	26.80 ±0.40^{b}	102.30 ±1.60^{b}	123.70 ±1.10^{c}	53.10 ±0.50^{d}	50.30 ±0.90^{f}	0.08 ±0.02^{c}	0.90 ±0.02^{a}	0.20 ±0.02^{c}	0.12 ±0.01^{f}
48	239 ±1.70^{d}	234.40 ±2.00^{d}	25.30 ±0.80^{d}	18.10 ±0.20^{d}	100.20 ±1.50^{d}	119.60 ±0.90^{d}	52.10 ±0.30^{f}	56.30 ±0.90^{b}	0.077 ±0.01^{d}	0.176 ±0.03^{d}	0.17 ±0.01^{d}	0.18 ±0.03^{c}
72	160 ±1.60^{e}	199 ±2.10^{e}	24.10 ±0.70^{e}	15.60 ±0.20^{e}	89.30 ±1.10^{e}	100.10 ±1.00^{e}	52.70 ±0.80^{e}	53.40 ±0.70^{c}	0.06 ±0.01^{e}	0.161 ±0.01^{e}	0.15 ±0.03^{f}	0.16 ±0.02^{e}
336	114 ±1.10^{f}	93.40 ±0.10^{f}	13.70 ±0.30^{f}	14.10 ±0.10^{f}	74.20 ±0.50^{f}	65.50 ±0.40^{f}	57.10 ±0.10^{a}	53.20 ±0.80^{d}	0.02 ±0.0^{f}	0.06 ±0.0^{f}	0.16 ±0.03^{e}	0.17 ±0.01^{d}

Changes in vitamins A and E in buffalo and cow colostrum during the first three days and after 14days of parturition are shown in Table (3). After 4 h postpartum the concentration of vitamin A in buffalo colostrum was found to be approximately 1.5 times lower than in bovine colostrum. As the postpartum time advanced, the concentration of vitamin A in both colostrums decreased to reach the values of 136.70±0.30 and 128.90±0.90 IU/100ml after 14 days in buffalo and cow colostrum respectively. As for bovine colostrum Klimeset *et al*., (1986) reported similar results. Also, Table (3) showed that the initial value of vitamin E was higher in buffalo than cow colostrum and its concentration in buffalo colostrum decreased after 48h postpartum and continued to decreased until the end of the experimental period, while vitamin E concentration in cow colostrum, had the opposit trend. As for cow colostrum, Klimes *et al.,* (1986) found that vitamin E concentration decreased during the first three days of parturition.

Table (3): Changes in vitamins A and E content (IU/100ml) colostrum during its transition to normal milk

Time (h)	Vitamin A		Vitamin E	
	B	C	B	C
4	166.70 ±0.90 [c]	270.80 ±2.10 [b]	402.00 ±4.20 [a]	210.2 ±02.30 [b]
12	١٤٥.٨٠ ±1.80 [e]	٣١٢.٥٠ ±٣.٣٠ [a]	336.60 ±3.20 [e]	198.00 ±1.90 [d]
24	188.00 ±1.60 [a]	١٨٧.٥٠ ±١.٨٠ [d]	396.00 ±3.90 [b]	201. 00 ±2.00 [c]
48	171.90 ±1.70 [b]	166.60 ±0.80 [e]	٣٨٧.٠٠ ±٣ .٦٠ [c]	١٧٥.١٠ ± ١.٦٠ [f]
72	156.70 ±2.40 [d]	208.30 ±1.50 [c]	378.10 ±3.50 [d]	١٨٦.٢٠ ± ١.٢.٠ [e]
336	١٣٦.٧٠ ±0.30[f]	١٢٨.٩٠ ±٠.٩٠[f]	330.00 ±2.90 [f]	318.00 ± 5.0 [a]

The coagulation/precipitation time at boiling temperature of buffalo and cow colostrum during the first four days and after 14 days of parturition are shown in figure (1). In the first calving, colostrum showed the least het stability with an average time of 5.5 min for buffalo and 7.0 min for caw. The heat stability of colostrum rapidly increased in the 12, 24, 48, 72h showing an average time of 8.75, 15, 24, and 30 min for buffalo and 12, 20, 29, and 41min for cow respectively whilst no change (coagulation/precipitation) was observed in 14th day postpartum milk heated at similar temperature (boiling temperature) for both colostrums. The reason could be the high level of globular protein in first milking colostrum transited to low level up to 72h of parturition that cause the colostrum to coagulation or precipitate in similar fashion (Walstra & Denneo, 1984).

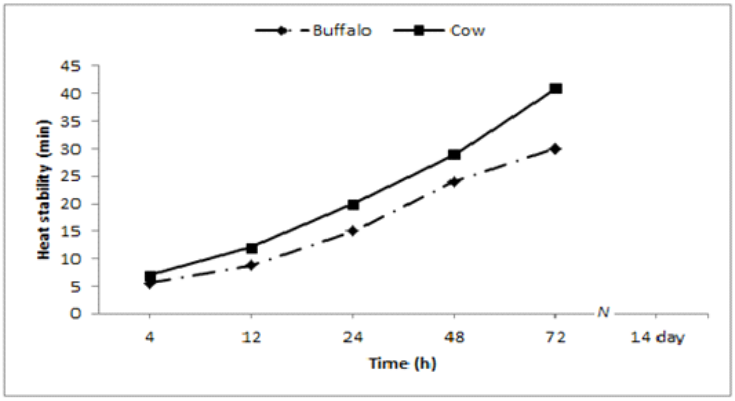

Fig.(1)changes in heat stability of buffalo and cow colostrum during its transition to normal milk.

Titratable acidity of first milking colostrum was observed as 0.39% for buffalo and 0.33% for cow, which were decreased to 0.34%, 0.31%, 0.30%, 0.27%, and 0.17% for buffalo and 0.31%, 0.27%, 0.26%, 0.25%, and 0.16% for bovine in 12, 24, 48, 42 and 366h of parturition, respectively (figure 2). Results observed were with the range as reported by Prasad (1997), whilst, not in line with the result of Ferrerion *et al* (١٩٨٠) ,.who reported 0.24% and 0.75% acidity of buffalo colostrum milked after 6h and 54h postpartum, respectively.

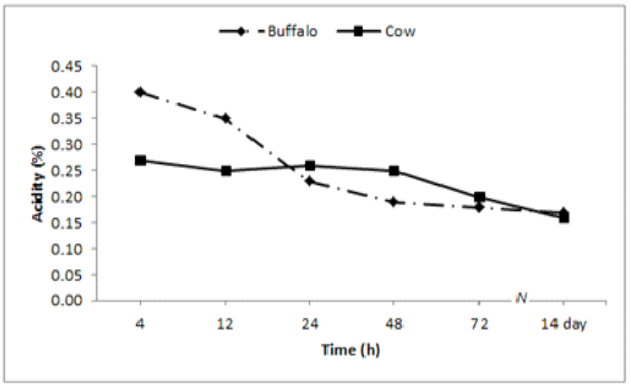

Fig.(2) changes in titratable acidity of buffalo and cow colostrum during its transition to normal milk.

The changes in the pH values in buffalo and cow colostrum during 4, 12, 24, 48, 72 and 366h after calving are shown in figure (3).pH value of first postpartum milk was inclined from 6.3 to 6.33 6.38, 6.37, 6.40 and 6.60 of buffalo and from 6.35 to 6.38, 6.40, 6.43, 6.45 and 6.7 for cow after 4,12, 24, 48, 72 and 366h of parturition, respectively . These observation were similar to that of reported by Ferreiro *et al*., (1980) and Fal & Hughes (1987). From the foregoing results it could be argued that the variation in pH and acidity of buffalo and cow colostrum during first 72h postpartum milking took opposite as expected. However, both acidity and pH values gradually changed to more or less their levels in normal milk after 72h postpartum milking. Similar trend in change of acidity and pH values were observed by Haggag *et al*., (1991).

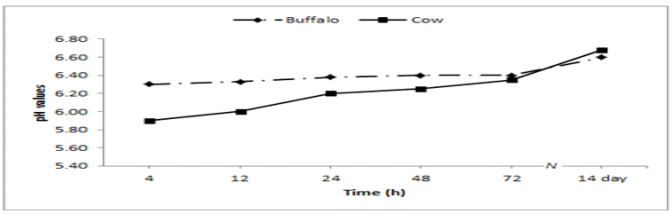

Fig.(3)changes in pH values of buffalo and cow colostrum during its transition to normal milk

Specific gravity of first buffalo colostrum (1.06±) and first cow colostrum (1.045±) were decreased markedly in 12, 24, 48, and 72h postpartum milking to 104, 1.039, 1.038, 1.04 and 1.034 for buffalo and to1.039, 1.08, 1.035, 1.033, and 1.032 for cow respectively (figure 4). These results indicate a general resemblance to the reported results of different works (Haggagg *et al*١٩٩١ ,.and Prasad, 1997.

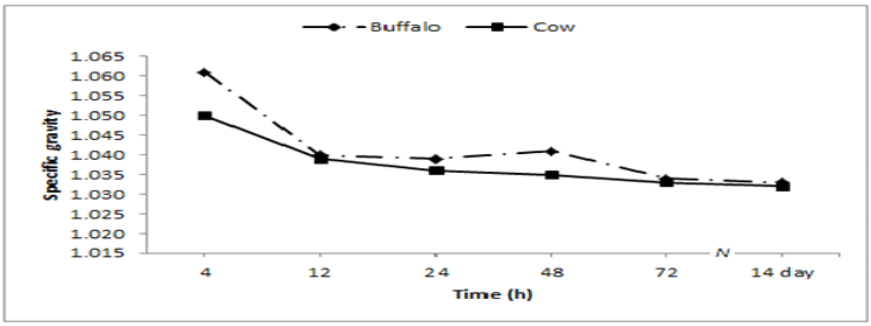

Fig.(4) changes in specific gravity of buffalo and cow colostrum during its transition to normal milk

Changes in viscosity in buffalo and cow colostrum during the first four days and after 14 days of parturition are shown in figure (5).It was high shortly after parturition (5.8± 0.04cP) for buffalo and (5.05±0.05cP) for cow and then dropped markedly up to 12, 24, 48 and 72h postpartum 3.17cP, 1.78cP, 1.34cP and 1.10cP for buffalo and 2.807cP, 1.38cP, 1.10cP, 1.05cP and 1.02cP for cow respectively. Present results is remarkably higher than of reported by different workers (Singls & Fox,1989 and Prasad, 1997). However, the change in viscosity of colostrum could be correlated with concentration of total solids content of colostrum (Sing & Singh, 1980) which was appeared in higher percentage in the present study .

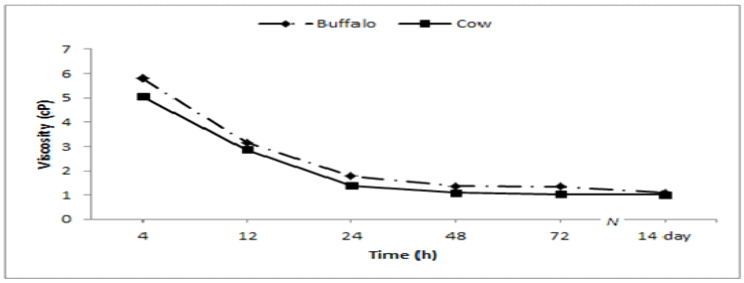

Fig.(5)changes in viscosity of buffalo and cow colostrum during its transition to normal milk.

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دراسة كيميائية و فيزيائية للمقارنة بين اللبأ الجاموسى والبقرى المصري

علاء الدين أحمد مرسى يونس - لبنى أحمد محمد و سلوى السيد إبراهيم الزلاط
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أجريت هذه الدراسة لتقييم بعض التغيرات التى تحدث فى اللبأ الجاموسى والبقرى المصري، والتى جمعت بعد ٤و ١٢و٢٤و ٤٨و ٧٢ ساعة ثم بعد٣٣٦ساعة (١٤ يوم) من الولادة من حيث التركيب والثبات الحرارى و خصائص الجودة . كما قدرت أيضا المواد الصلبة الكلية و البروتين الكلي و بروتينات الشرش و والدهن واللاكتوز و الرماد و بعض الأملاح المعدنية والفيتامينات (A و E) وكذلك تم تقدير الثبات الحرارى ومعامل الحموضة و قيمة الأس الهيدروجيني والوزن النوعي و اللزوجة.

ولقد جد أن تركيز البروتين الكلى وبروتينات الشرش أعلى فى اللبأ البقرى عنه فى اللبأ الجاموسى ، في حين كانت تركيزات المواد الصلبة الكلية والدهن واللاكتوز والرماد فى اللبأ الجاموسى أعلى منها فى اللبأ البقرى. بينما انخفضت نسبة جميع المكونات تدريجيا مع زيادة الزمن بعد الولادة باستثناء اللاكتوز فإنه يزيد بعد ٧٢ساعة من الولادة. حيث كانت نسبة النقص فى تركيز البروتين الكلي وبروتينات شرش اللبن والدهن والرماد و المواد الصلبة الكلية ٤٧.٢،٧٢.٢ ، ٢٩.٩ ٠٣٠.٠ و ٢٨.٩ ٪ فى اللبأ ا لجاموسى على الترتيب وبنسبة ٤٥.١ ، ٧٣.٢ ، ٣١.٥ ، ١٦.٤ و ٣٣.٠ ٪ فى اللبأ البقرى على الترتيب. بينما أزداد تركيز اللاكتوز فى اللبأ الجاموسى بنسبة ٦٠.٠ % و فى اللبأ البقرى بنسبة ٦٨.٤ ٪. كما أظهرت النتائج أن تركيز الأملاح المعدنية فى كلا من اللبأ البقرى والجاموسى يميل إلى الانخفاض قليلا إلى أن يصل الى التركيز الطبيعي في اليوم الرابع عشر من الولادة . وأثبتت النتائج أن تركيز فيتامينE فى اللبأ الجاموس أعلى من تركيزه باللبأ البقرى، بينما كان اللبأ البقرى يحتوى على تركيز من فيتامين (أ) أعلى من الموجود باللبأ الجاموسى وذلك بعد ٤ ساعات من الولادة . أما بالنسبة للثبات الحرارى لكل من اللبأ البقرى والجاموسى بعد أربع ساعات من الولادة فكانت(٥.٥ و ٧.٠ دقيقة) على التوالي ، و زادت تدريجيا بعد ١٢ ساعة) ٨,٧٥ و ١٢دقيقة) بعد ٢٤ ساعة (١٥و ٢٠ دقيقة) بعد ٤٨ (٢٤و ٢٩ دقيقة) وبعد ٧٢ ساعة (٣٠ و٤١ دقيقة). بينما فى اليوم الرابع عشر بعد الولادة لا يحدث تجبن. أما بالنسبة للحموضة ، وقيمة الأس الهيدروجينى ، والوزن النوعي و اللزوجة فى اللبأ والحليب الجاموسى و البقرى بعد الولادة فكانت (٠,٣٩ و٠,٣٣ %) و (٦,٣ و٦,٣٥) و١,٠٦ و(١,٠٥) و ٥,٨(و ٥,٠٥) على التوالي، و انخفضت بشكل ملحوظ إلى (٠,١٧ و ٠,١٦ %) و (٦,٦ و ٦,٧) و (١,٠٣٤ و ١,٠٣٢) و (١,١٠ و ١,٠٢ بواز) فى العينات بعد١٤ يوما بعد الولادة على التوالى.

لذا توصى الدراسة بضرورة تناول اللبأ سواء الجاموسي أو البقري خلال ال ٧٢ ساعة الأولى من الولادة وذلك لقيمته الغذائية العالية.

قام بتحكيم البحث

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