Original Research

Effect of the Lactation Number during Transition Phase on Various Physico-Chemical, Compositional and Microbiological Characteristics of Bovine Colostrum

Tahir Nazir*, Mohammad Ashraf Pal, Ashaq Manzoor, Irshad Maqbool[1], Bilal Ahmad Mir[2] and Asif Hassan Sofi

Division of Livestock Products Technology, Faculty of Veterinary Sciences & Animal Husbandry, SKUAST-Kashmir -190006, Jammu and Kashmir, INDIA

[1]Division of Veterinary Parasitology
[2]Division of Veterinary Biochemistry

***Corresponding author:** thrnzr@gmail.com

Rec. Date:	Apr 21, 2019 14:52
Accept Date:	Jul 28, 2019 10:05
DOI	10.5455/ijlr.20190421025246

Abstract

The current study was undertaken to study the effect of lactation number on quality of bovine colostrum under temperate conditions. It was found that the specific gravity, fat, total protein, lactose and total solids content of the colostrum samples from second lactation cows were significantly ($p \leq 0.05$) lower than other lactations. Casein protein, whey proteins, solids not fat and electrical conductivity were comparable among different lactations. The specific gravity of the colostrum samples from first lactation cows was significantly ($p \leq 0.05$) higher than other lactation cows. The ash content of the colostrum samples of fourth lactation was significantly ($p \leq 0.05$) higher than first and second lactation however it was comparable other lactation samples. The pH the colostrum samples from fifth lactation cows was significantly ($p \leq 0.05$) lower than other lactations which among themselves possessed comparable ($p > 0.05$) values. The total plate count (TPC) of the colostrum samples from sixth lactation cows was significantly ($p \leq 0.05$) higher than other lactations which among themselves possessed comparable ($p > 0.05$) values.

Key words: Bovine Colostrum, Compositional, Lactation Number, Microbiological Characteristics, Physico-Chemical

How to cite: Nazir, T., Pal, M., Manzoor, A., Maqbool, I., Mir, B., & Sofi, A. (2019). Effect of the Lactation Number during Transition Phase on Various Physico-Chemical, Compositional and Microbiological Characteristics of Bovine Colostrum. International Journal of Livestock Research, 9(8), 243-256. doi: 10.5455/ijlr.20190421025246

Introduction

Colostrum is not only a good source of nutrients, it also has biologically active substances which are important for nutrition and health. Colostrum an early milk secreted at the time of parturition and is rich in

antibodies which acts as an immune booster for post-natal calf health (Verma *et al.*, 2018). The colostrum composition changes with a number of factors. The composition of mammary secretion varies during the whole lactation period to fulfill the changing metabolic needs of the new born from birth till weaning. Colostrum is the mammary secretion produced shortly after parturition (Levieux and Ollier, 1999), through first 24 h after parturition or during the first few days after calving (Tsioulpas *et al.*, 2007). Bovine colostrum has numerous purported health benefits, if harvested immediately after calving to maintain its quality. The concentration of total solids is higher in bovine colostrum compared to bovine milk (27.6%, w/w, versus 12.3%, w/w), because of greater protein content (14.9% versus 2.8%) and more fat content (6.7% versus 4.4%), whereas the concentration of lactose is lower (2.5% versus 4.0%) as reported by Fox and McSweeney (2003); Kehoe *et al.* (2007). The concentration of growth factors and immunoglobulins is highest in the first portion of colostrum, which decrease rapidly thereafter (Playford *et al.*, 2000; Blum, 2006). Immunoglobulins consist of greater than 50% of the total proteins present in colostrum, which comprise almost all antibodies, present in maternal blood. IgG1 constitutes about 90% of colostrum Ig (Gapper *et al.*, 2007).

The growth factors and immune factors present in bovine colostrum are similar to those present in human colostrum but in higher quantities: IgG concentration in human colostrum is 2% while in bovine colostrum it is 86% (Wilson, 1997). Bovine colostrum rebuilds the immune system, destroys viruses, bacteria and fungi, accelerates healing of all body tissue, helps lose weight, burn fat, increase bone and lean muscle mass and slows down and even reverses aging. There is variation of colostral Ig and lactoferrin concentrations of dairy cows with lactation number. The primiparous cows have lower values than multiparous cows. Plasma Ca and inorganic P (PI) concentration of dairy cows decreased around parturition because of the large transfer of Ca and P to colostrum, and older cows have a greater risk of developing milk fever. The lactation number is a factor altering mineral concentration of colostrum, concurrently shifting the mineral status of newborn calves and postpartum cows (Kume and tanabe,1993). Colostrum quality is higher in the animals which give birth to male calves than in animals which give birth to female calves (Nazir *et al*, 2018).

Materials and Methods

Source of Colostrum

Colostrum samples were collected from the MLRI, SKUAST-Kashmir and various field locations. A total of ninety-nine samples were collected. The samples were collected in sterile containers and transported to the laboratory in ice cool totes, thereafter the samples were analyzed for the following parameters for three consecutive days post parturition as per approved procedures-

 DOI 10.5455/ijlr.20190421025246

1. Specific gravity (Lactometer method)
2. Total protein (Kjeldahl/Formal titration method)
3. Casein protein (Kjeldahl/Formal titration method)
4. Whey protein (Kjeldahl/Formal titration method)
5. Fat (Gerber method)
6. Lactose (Lane-Eynon Oxidation –Reduction Reaction method)
7. Ash (Incineration method)
8. Total solids (Gravimetric method)
9. SNF (By Difference)
10. pH (Microprocessor based electrical pH meter)
11. Electrical conductivity (electrical conductivity meter)
12. Total plate count (APHA)

Chemicals

All the chemicals used were of analytical grade and were obtained from standard firms (Qualigens Fine Chemicals, Nice Chemicals Pvt. Ltd., Hi Media Lab. Pvt. Ltd. etc.).

Preparation of Samples

Colostrum Samples

Colostrum was warmed and thoroughly mixed by pouring into the clean receptacle and back repeatedly and whenever needed with plunger/stirrer to reincorporate any material adhering to containers in order to make sure that the samples collected were representative of the entire batch of colostrum that was being sampled. After thorough mixing about 200ml of colostrum was taken in sampling bottles with the help of colostrum sampler and the analysis was carried out immediately.

Laboratory Analysis

All the analytical procedures required for the analysis of colostrum were carried out in the laboratory of the Division of Livestock Products Technology, Faculty of Veterinary Sciences and Animal Husbandry, SKUAST-Kashmir, Shuhama Alusteng, Ganderbal. For physico-chemical analysis about 200ml of colostrum was used for the determination of various parameters.

pH of Colostrum

The pH of colostrum samples was recorded by directly dipping the combined electrode of digital pH meter (Tanco Lab. Equipments), after proper calibration of the instrument, into the samples. Two readings were taken for each sample and average pH recorded.

Specific Gravity of Colostrum

For determination of specific gravity of colostrum, Zeal type lactometer was used. After recording the temperature of the sample correctly lactometer reading was recorded. The corrected lactometer reading was

 DOI 10.5455/ijlr.20190421025246

calculated to arrive at the correct specific gravity

Electrical Conductivity (EC) of Colostrum

Electrical conductivity of the samples was taken by dipping the electrode of electrical digital conductivity meter (brand "TANCO, India Lab. Equipment's") into the sample after proper calibration of instrument. Two or three readings were taken for each sample and average electric conductivity was calculated.

Proximate Composition

The colostrum samples were analyzed for determination of various physico-chemical parameters using the standard procedures of Association of Official Analytical Chemists (A.O.A.C., 1995). Brief description of the methods is outlined below-

Total Solids (TS) of Colostrum

For the determination of total solids about 10g of the colostrum sample in duplicate was weighed accurately on electronic balance, corrected up to 0.1mg, in a dry, pre-weighed, flat bottomed moisture cups and kept in hot air oven at 102 ±1°C for 4 hours. Then moisture cups were transferred immediately to a desiccator to cool to the room temperature (at least 30 minutes). The process of drying, cooling and weighing was repeated at 30 minutes interval until the difference between the two consecutive weighing readings was less than one milligram. Weight loss of the cup after drying was recorded and expressed in terms of total solids percent.

$$\% \text{ Total solids} = [(W_1 - W)/ (W_2 - W)] \times 100$$

Where,
W = weight of empty dried cup (g)
W_1 = weight of cup + sample after drying (g)
W_2 = weight of cup + sample (g)

Solids Not Fat (SNF) (Colostrum)

SNF of the colostrum was calculated by indirect method. The difference between total solids (%) and fat (%) gave the SNF content in colostrum.

$$\text{SNF (\%)} = \text{TS\%} - \text{Fat\%}$$

Fat (Colostrum)

Fat of colostrum was estimated by Gerber's method (IS: 1224 (1977). 10ml of Gerber's sulphuric acid (90ml of concentrated sulphuric acid added to 10ml of distilled water) was taken carefully in a clean dry butyrometer (ISI marked) with the help of automatic dispenser (tilt measure) without wetting the neck. To this 10.75 ml of thoroughly mixed colostrum sample was added with the help of milk pipette on the side

 DOI 10.5455/ijlr.20190421025246

walls of the butyrometer. Then 1ml of amyl alcohol was added to the butyrometer on the sides. Dry rubber lock stopper was used to close the butyrometer. These were then shaken and inverted 2-3 times till complete dissolution of the acid and colostrum contents. Then tubes were placed in water bath for 5 minutes at 65±2°C to ensure that all the casein particles were dissolved. The butyrometer tubes were then placed in a centrifuge in a radial symmetry and as evenly spaced as possible. Centrifugation was done for 4 minutes at 1100 rpm. Butyrometer tubes were then removed from centrifuge and placed again in water bath for 5 minutes at 65±2°C. With the help of stopper and key, the fat level was adjusted in such a way that scale reading corresponds to the lowest point of the fat meniscus and the surface of separation of the fat and acid. The observed fat level was recorded as percent fat of test sample.

Protein

Micro-kjeldahl method was followed for determination of protein content of colostrum (AOAC, 2000).

Ash

For determination of ash about 10 ml of colostrum samples in duplicate were accurately weighed on electronic balance, corrected upto 0.1 mg, in dried and preweighed crucibles and kept in hot air oven at 102 ±1°C for 4 hours. The sample in the crucible was subjected to carbonization followed by incineration of the sample by placing the crucible in muffle furnace at 550°C - 600°C for about 2 hours (AOAC, 2000).

Lactose

Lane-Eynon Oxidation–Reduction Reaction method was followed for determination of lactose content of colostrum samples. About 25 ml of colostrum was taken in a 500 ml conical flask and diluted with distilled water to about 200 ml. About 3.75 ml of 10 per cent acetic acid solution were added to it and then subjected to boiling. On cooling, it was transferred quantitatively to a 250 ml volumetric flask and the volume was made up to mark with distilled water. It was then filtered through a filter paper and the filtrate was collected in a dry conical flask. The burette was filled with this filtrate. 5 ml of each of Fehling solution A and B were pipetted into 250 ml of conical flask and preliminary titration was made by adding the filtrate containing lactose, from the burette, 1 ml at a time, to the Fehling solution kept boiling till the blue colour changes to red. About 5 drops of methylene blue indicator were added to the boiling mixture and titration was completed within a total boiling time of 3 minutes by additions of 4 to 6 drops of the filtrate till end point was reached indicated by the change of blue colour to colourless supernatant.

$$\text{Lactose (\%)} = \text{W/V} \times 250 \times 100/25 \times 1/1000$$

Where,
V = Volume of filtrate required for complete reduction of 10 ml of Fehling solution
W = Lactose equivalent in mg for V ml

Hosted@www.ijlr.org DOI 10.5455/ijlr.20190421025246

Microbiological Analysis

The colostrum samples were collected in sterile containers and bought under hygienic conditions to the laboratory of Division of LPT, F. V. Sc. and A. H., SKUAST-K, were subjected to microbiological analysis for total plate count using standard plate count technique as per APHA (2004).

Sample Preparation and Serial Dilution

About 10ml of colostrum was aseptically transferred to a pre-sterilized volumetric flask and 90ml of peptone water was added to it to get solution of 10^{-1} dilution. About 1ml of this diluted solution was transferred to another tube containing 9ml of sterile 0.1 percent peptone water (peptone from Qualigens Fine Chemicals) to get 10^{-2} dilution. This procedure was repeated to obtain 10^{-3} dilution and so on, until appropriate dilution was achieved which yielded plates with 25 to 250 colony forming units (cfu). All the procedures were performed in the sterilized environmental conditions of laminar air flow (NSW-201 Horizontal Laminar Flow cabinet).

Total Plate Count

For determination of TPC, total plate count agar (Hi-Media Laboratories, Pvt. Ltd., Mumbai) was used. About 17.5g of it was dissolved in 1000ml of distilled water followed by sterilization in an autoclave at 15 lb pressure (121ºC) for 15 minutes and cooled to remain at 45ºC. With the help of sterile pipette serial dilutions of sample were made and 1ml from each test tube was inoculated into a double set of pre-sterilized petridishes. Pour plate technique were followed for plating. The innoculum and media in petridishes were mixed thoroughly and uniformly by rotating the plates alternatively in clockwise and anticlockwise directions followed by back and forth motion on level surface. When media in plates solidified, they were inverted and incubated aerobically at 35±1°C for 24±3 hours. The number of micro-organisms per ml of sample was calculated by selecting plates containing 25 to 250 cfu/ml or selecting plates with count closest to this range. The cfu/ml was calculated by using the formula-

$$N = \sum C / [(1 \times n_1) + (0.1 \times n_2)] d$$

Where,
N = number of colonies per milliliter of product
$\sum C$ = sum of all colonies on all plates counted
n_1 = number of plates in lower dilution counted
n_2 = number of plates in next higher dilution counted
d = dilution from which the first counts were obtained

Finally, the cfu/ml was expressed as $\log_{10}$ cfu/ml of sample

Statistical Analysis

The data obtained from duplicate samples were averaged and the data so generated were analyzed statistically following the method of Snedecor and Cochran (1980), Gomez and Gomez (1984) and Steel

 DOI 10.5455/ijlr.20190421025246

and Torrie (1984). The data was processed in a computer using SPSS software package. The analysis of variance of group mean was computed and significance of means tested by using least significant difference test at 5 per cent level of significance. One-way and two-way analysis of variance with all possible interactions was carried out. The nested means were compared when the interaction was found to be significant. In the absence of such significance the overall means were compared.

Results and Discussion

The data pertinent to the study related to the effect of the Lactation number and transition period on various physico-chemical, compositional and microbiological characteristics of bovine colostrum has been outlined in Table 1 and graphically portrayed in Fig.1 and 2. As indicated by the result, irrespective of the lactation number of the animal, the day 1 postpartum colostrum samples had significantly ($p \leq 0.05$) higher specific gravity than day 2 and day 3 colostrum samples and between the latter two samples the day two samples had significantly ($p \leq 0.05$) higher specific gravity compared to day three samples. The results agree favourably with those of Foley and Otterby (1978), Quigley III *et al* (1994), Morin *et al* (2001) and Sobczuk-Szul *et al* (2013). Without regard to the days of transition, the specific gravity of the colostrum samples from second lactation cows was significantly ($p \leq 0.05$) lower than first lactation cows. The findings are parallel to the findings of Quigley III *et al.* (1994). The specific gravity of the colostrum samples from first lactation cows was significantly ($p \leq 0.05$) higher than other lactation cows. These results corroborate the findings of Morin *et al.* (2001). The fat content of the colostrum samples during days periods postpartum showed a declining trend with values being significantly ($p \leq 0.05$) different from one another, irrespective of the lactation number of the animal under study. The values are close to the values reported by Foley and Otterby (1978), Klimes *et al.* (1986) and Raducan *et al.* (2013). As far as the fat values of the colostrum samples from different lactation numbers are concerned, without regard to the days of transition, the fat content of the colostrum samples from second lactation cows was significantly ($p \leq 0.05$) lower than other lactations.

The results are parallel to the findings as reported by Morill *et al.* (2012). Total protein content of the colostrum during the transition period postpartum declined progressively with values at each day under study being significantly ($p \leq 0.05$) different from one another. Similar results are reported by Foley and Otterby (1978), Klimes *et al.* (1986), Elfstrand *et al.* (2002) and Raducan *et al.* (2013). Regardless of the days of transition, the total protein content of the colostrum samples from second lactation cows was significantly ($p \leq 0.05$) lower than other lactations. Similar results have been cited by Quigley III *et al.* (1994). The casein protein content of the colostrum samples on day 1 were significantly lower than day 2 and day 3 while the values at day 2 were significantly higher than day 3. Similar trend was reported by Benheng and Chengxiang (1996). Without regard to the days of transition, the Casein protein content of the

DOI 10.5455/ijlr.20190421025246

colostrum samples among different lactations was comparable. The results agree favourably with the findings of Quigley III *et al.* (1994).

Table 1: Effect of the lactation number during transition phase on various physico-chemical, compositional and microbiological characteristics of bovine colostrum (Mean ±S.E.)

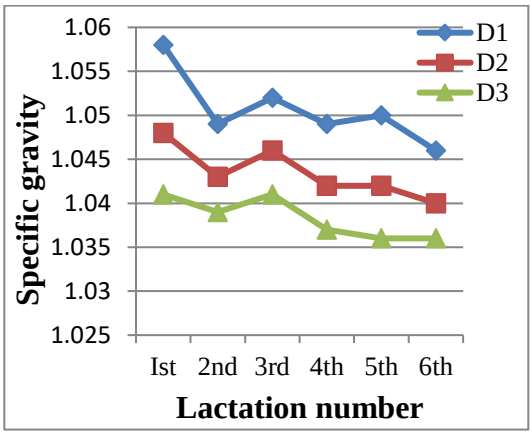
Days postpartum	Lactation number						Overall mean
	Ist	2ND	3RD	4TH	5TH	6TH	
Specific gravity							
D1	1.058±0.004	1.049±0.002	1.052±0.005	1.049±0.005	1.050±0.006	1.046±0.005	**1.051±0.002^{1}**
D2	1.048 ±0.003	1.043 ±0.002	1.046 ±0.004	1.042 ±0.003	1.042±0.005	1.040±0.003	**1.044±0.001^{2}**
D3	1.041 ±0.002	1.039 ±0.001	1.041 ±0.003	1.037 ±0.002	1.036 ±0.004	1.036 ±0.002	**1.039±0.001^{3}**
Overall mean	**1.049±0.002^{a}**	**1.043±0.001^{b}**	**1.046±0.002^{ab}**	**1.043±0.002^{b}**	**1.043±0.003^{b}**	**1.041±0.002^{b}**	**1.045±0.001**
Fat (%)							
D1	8.0±0.49	7.1±0.49	8.2±0.63	7.7±0.64	7.4±1.22	6.5±1.44	**7.6±0.27^{1}**
D2	6.1±0.24	6.0±0.38	6.1±0.35	6.3±0.51	6.3±1.23	5.6±1.27	**6.1±0.20^{2}**
D3	5.1±0.20	5.0±0.36	5.0±0.22	4.9±0.25	4.8±0.97	4.6±0.84	**5.0±0.15^{3}**
Overall mean	**6.4±0.32^{a}**	**5.7±0.30^{b}**	**6.4±0.40^{a}**	**6.3±0.41^{a}**	**6.3±0.68^{a}**	**5.6±0.66^{b}**	**6.2±0.16**
Total protein (%)							
D1	12.2±0.83	10.5±0.69	12.1±1.22	11.7±1.46	12.2±2.39	10.2±2.76	**11.6±0.48^{1}**
D2	9.1±0.65	8.3±0.39	8.9±0.78	9.7±1.15	10.1±2.47	8.8±1.96	**9.1±0.36^{2}**
D3	7.1±0.56	7.4±0.23	7.3±0.47	7.6±0.74	7.3±1.22	7.4±1.05	**7.3±0.22^{3}**
Overall mean	**9.5±0.60^{a}**	**8.6±0.39^{b}**	**9.6±0.68^{a}**	**9.7±0.77^{a}**	**9.8±1.28^{a}**	**8.8±1.10^{b}**	**9.3±0.28**
Casein protein (%)							
D1	3.3±0.24	3.2±0.24	3.7±0.40	3.3±0.39	3.5±0.81	2.9±1.08	**3.3±0.16^{1}**
D2	6.9±0.46	6.8±0.31	6.4±0.51	7.3±0.85	7.7±1.90	6.6±1.30	**6.9±0.26^{2}**
D3	5.5±0.42	5.7±0.18	5.4±0.37	5.8±0.55	5.7±0.96	5.6±0.72	**5.6±0.17^{3}**
Overall mean	**5.2±0.39^{a}**	**5.0±0.32^{a}**	**5.2±0.36^{a}**	**5.4±0.55^{a}**	**5.6±0.89^{a}**	**5.1±0.77^{a}**	**5.3±0.19**
Whey protein (%)							
D1	8.9±0.68	7.8±0.49	8.3±0.84	8.5±1.17	8.7±1.88	7.3±1.67	**8.2±0.35^{1}**
D2	2.2±0.22	2.0±0.09	2.5±0.30	2.3±0.30	2.4±0.59	2.2±0.66	**2.2±0.11^{2}**
D3	1.6±0.14	1.7±0.05	1.8±0.16	1.7±0.20	1.6±0.26	1.8±0.33	**1.7±0.06^{2}**
Overall mean	**4.2±0.77^{a}**	**3.6±0.57^{a}**	**4.2±0.76^{a}**	**4.2±0.90^{a}**	**4.2±1.26^{a}**	**3.8±1.03^{a}**	**4.1±0.32**
Lactose (%)							
D1	2.7±0.06	2.8±0.05	2.7±0.09	2.7±0.09	2.6±0.09	2.7±0.03	**2.7±0.03^{1}**
D2	3.4±0.12	3.2±0.11	3.4±0.15	3.4±0.12	3.2±0.21	3.1±0.12	**3.3±0.06^{2}**
D3	3.8±0.12	3.8±0.14	3.7±0.09	3.8±0.17	3.6±0.25	3.4±0.17	**3.6±0.07^{3}**
Overall mean	**3.3±0.12^{a}**	**2.9±0.11^{b}**	**3.2±0.13^{a}**	**3.3±0.14^{a}**	**3.3±0.17^{a}**	**3.1±0.11^{ab}**	**3.2±0.05**
Total solids (%)							
D1	26.1±1.18	23.2±1.27	25.7±1.58	25.8±2.48	25.3±4.26	23.0±3.79	**25.0±0.75^{1}**
D2	20.9±0.70	19.0±0.72	20.3±0.95	21.2±1.88	21.3±3.71	19.3±3.53	**20.0±0.56^{2}**
D3	17.9±0.46	17.6±0.56	17.5±0.66	17.9±1.23	17.3±2.73	16.8±2.66	**17.6±0.40^{3}**
Overall mean	**21.6±0.89^{a}**	**19.3±0.73^{b}**	**21.1±1.03^{a}**	**21.3±1.28^{a}**	**21.3±2.15^{a}**	**19.9±1.91^{b}**	**21.0±0.45**
Solids not fat (%)							
D1	18.2±0.80	16.7±0.89	17.5±1.00	17.3±1.74	17.9±3.16	16.5±2.62	**17.4±0.52^{1}**
D2	14.8±0.62	14.0±0.46	14.1±0.77	15.1±1.30	15.1±2.49	13.8±2.34	**14.4±0.39^{2}**
D3	12.8±0.53	12.4±0.28	12.5±0.61	13.1±0.96	12.5±1.83	12.1±1.88	**12.6±0.29^{3}**
Overall mean	**15.2±0.62^{a}**	**14.0±0.48^{a}**	**14.7±0.67^{a}**	**15.2±0.86^{a}**	**15.2±1.50^{a}**	**14.1±1.32^{a}**	**14.8±0.31**
Ash (%)							
D1	1.09±0.05	0.96±0.03	1.13±0.11	1.42±0.27	1.31±0.44	1.2±0.12	**1.14±0.06^{1}**
D2	0.87±0.02	0.85±0.02	0.88±0.04	0.97±0.08	0.86±0.12	0.92±0.07	**0.88±0.02^{2}**
D3	0.79±0.03	0.76±0.02	0.82±0.03	0.84±0.05	0.77±0.07	0.82±0.04	**0.79±0.01^{2}**

 DOI 10.5455/ijlr.20190421025246

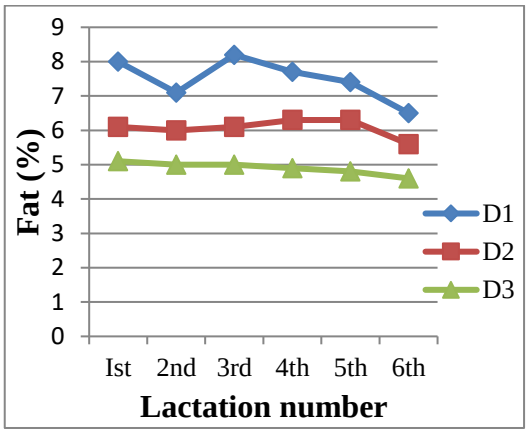
Overall mean	**0.92±0.03^{a}**	**0.84±0.02^{a}**	**0.94±0.05^{ab}**	**1.08±0.11^{b}**	**0.98±0.16^{ab}**	**0.98±0.07^{ab}**	**0.94±0.03**
pH							
D1	6.36±0.02	6.38±0.02	6.38±0.03	6.39±0.02	6.32±0.02	6.42±0.05	**6.38±0.01^{1}**
D2	6.43±0.03	6.47±0.03	6.45±0.02	6.46±0.02	6.36±0.02	6.48±0.03	**6.45±0.01^{2}**
D3	6.54±0.04	6.53±0.04	6.54±0.03	6.52±0.03	6.43±0.02	6.6±0.02	**6.53±0.02^{3}**
Overall mean	**6.45±0.02^{a}**	**6.46±0.02^{a}**	**6.45±0.02^{a}**	**6.45±0.02^{a}**	**6.37±0.02^{b}**	**6.50±0.03^{a}**	**6.45±0.01**
Electrical conductivity (mScm^{-1})							
D1	5.6±0.20	5.6±0.24	5.8±0.31	5.4±0.24	5.3±0.33	5.7±0.33	**5.6±0.11^{1}**
D2	4.9±0.26	4.8±0.22	5.0±0.37	4.8±0.37	4.3±0.33	4.7±0.33	**4.8±0.12^{2}**
D3	4.1±0.14	4.2±0.15	4.5±0.22	4.4±0.24	4.3±0.33	4.0±0.00	**4.3±0.08^{3}**
Overall mean	**4.9±0.17^{a}**	**4.9±0.16^{a}**	**5.1±0.21^{a}**	**4.9±0.19^{a}**	**4.7±0.24^{a}**	**4.8±0.28^{a}**	**4.9±0.08**
Total plate count (log$_{10}$cfu/ml)							
D1	4.6±0.08	4.6±0.08	4.6±0.06	4.7±0.08	4.7±0.11	4.8±0.04	**4.6±0.03^{1}**
D2	4.7±0.05	4.8±0.06	4.7±0.05	4.8±0.07	4.8±0.07	4.9±0.04	**4.8±0.02^{2}**
D3	4.8±0.03	4.9±0.06	4.8±0.04	4.9±0.06	4.9±0.04	5.1±0.05	**4.9±0.02^{3}**
Overall mean	**4.7±0.04^{a}**	**4.8±0.04^{a}**	**4.7±0.04^{a}**	**4.8±0.04^{a}**	**4.8±0.05^{a}**	**4.9±0.04^{b}**	**4.8±0.02**

Mean±SE with different superscripts row-wise (alphabets) and column wise (numerals) differ significantly (p≤0.05)

The whey protein content of the colostrum samples during various periods postpartum showed a declining trend with the values at day 1 being significantly ($p \leq 0.05$) higher compared to either day 2 or day 3 which within themselves were comparable. These results corroborate the findings of Klimes *et al* (1986) and Benheng and Chengxiang (1996). Without regard to the days of transition, the whey protein content of the colostrum samples showed no significant ($p > 0.05$) difference among different lactation.



(a)



(b)

DOI 10.5455/ijlr.20190421025246

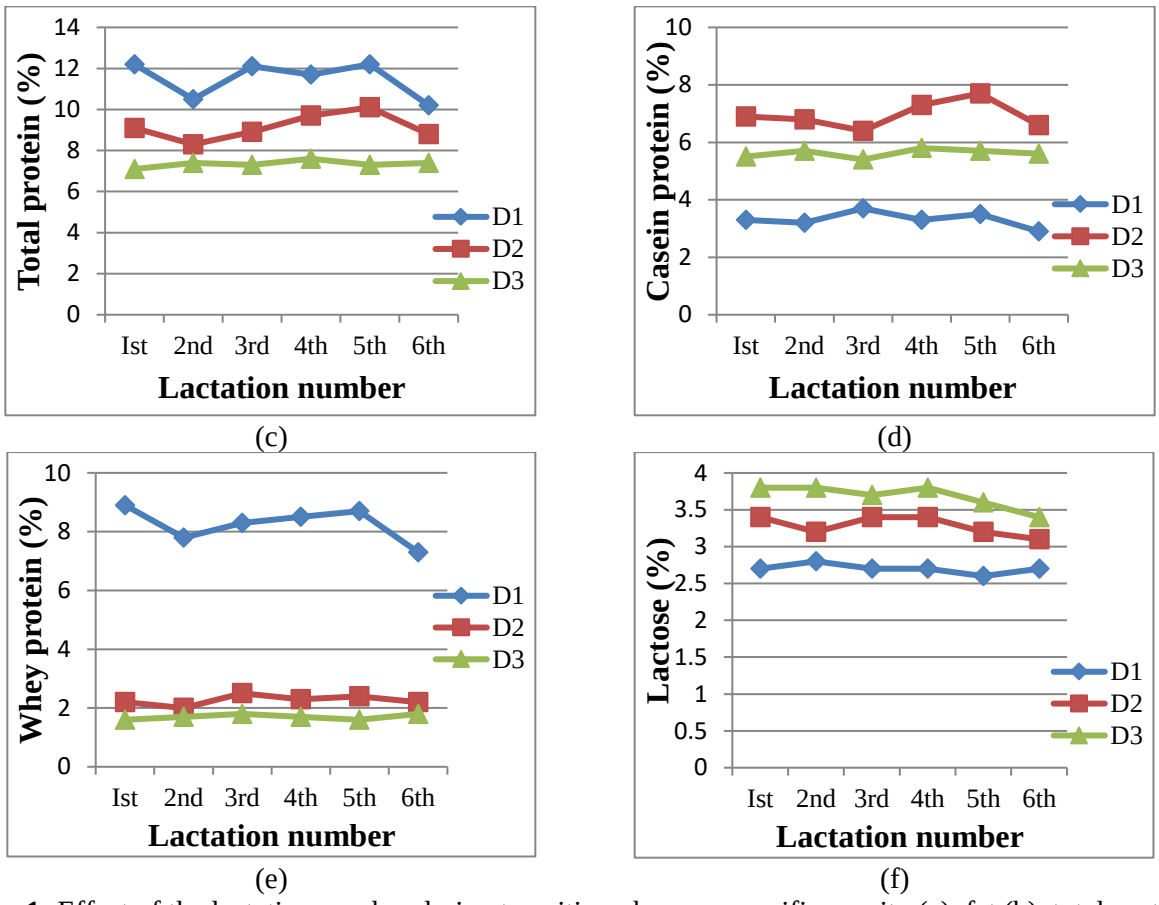
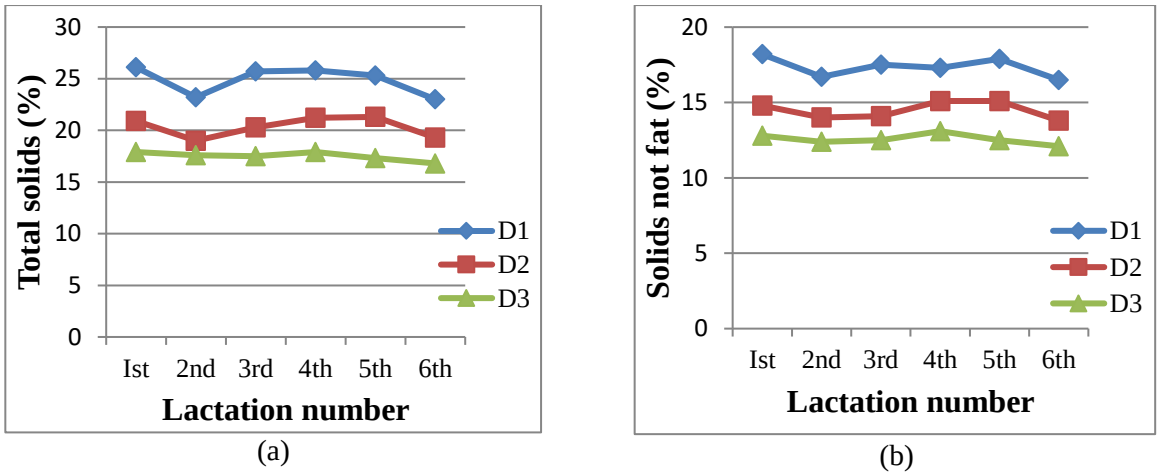


Fig. 1: Effect of the lactation number during transition phase on specific gravity (a), fat (b), total protein (c), casein protein (d), whey protein (e) and lactose (f) of bovine colostrum.



DOI 10.5455/ijlr.20190421025246

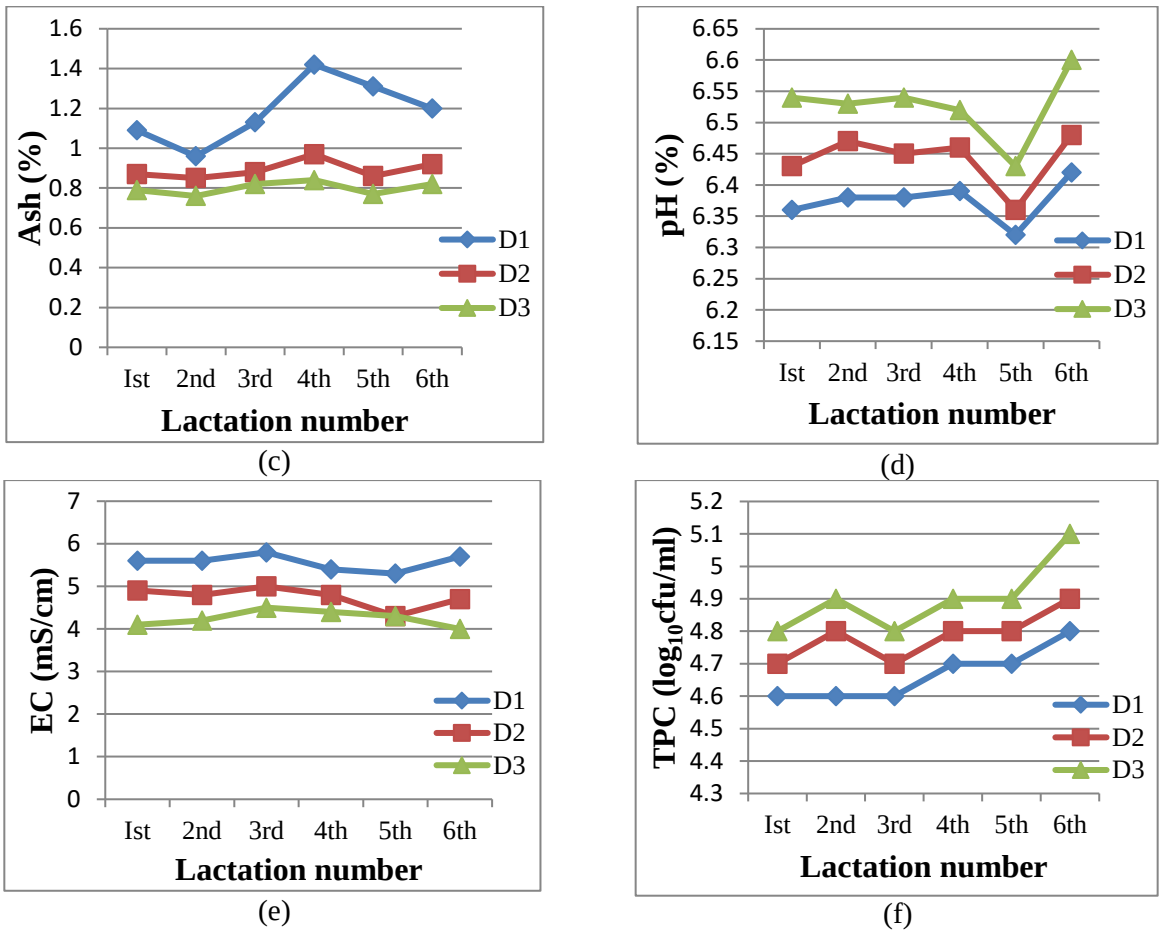


Fig. 2: Effect of the lactation number during transition phase on total solids (a), solids not fat (b), ash (c), pH (d), electrical conductivity (e) and total plate count (f) of bovine colostrum

Lactose while opposing the decreasing tendency of other parameters, went on increasing with each passing day post-partum having lowest value at day 1 and highest at day 3 postpartum, all the three values were significantly ($p \leq 0.05$) different from one another. The findings of Foley and Otterby (1978), Benheng and Chengxiang (1996), Elfstrand *et al.* (2002) and Kleinsmith (2011) are in close conformity with the outcome of the current study. Irrespective of the days of transition the lactose content of colostrum samples of second lactation was significantly ($p \leq 0.05$) lower than the lactose content of colostrum samples of first, third, fourth and fifth lactation however the values compared favourably with sixth lactation values. The values are more or less close to the values reported by Morill *et al.* (2012). Total solids of the colostrum samples during various periods postpartum went on decreasing with values being significantly ($p \leq 0.05$) different from one another, irrespective of the age of the animal under study. Similar trend has been reported by Foley and Otterby (1978), Klimes *et al.* (1986) and Raducan *et al.* (2013). As far as the total solids value of the colostrum samples from different lactation numbers is concerned, the colostrum samples from second

DOI 10.5455/ijlr.20190421025246

lactation cows had significantly ($p \leq 0.05$) lower total solids than other lactations. Similar results are reported by Quigley III *et al.* (1994) and Morill *et al.* (2012).

Irrespective of the different lactation numbers the day 1 postpartum colostrum samples had significantly ($p \leq 0.05$) higher solids not fat than day 2 and day 3 colostrum samples and between the latter two samples, the day 2 samples had significantly ($p \leq 0.05$) higher solids not fat compared to day 3 samples. Similar trend has been reported by Raducan *et al.* (2013). As far as the solids not fat value of the colostrum samples from different lactation numbers are concerned, there was no significant ($p > 0.05$) difference among them. Without taking into account different lactation numbers, the day 1 postpartum colostrum samples had significantly ($p \leq 0.05$) higher ash content than day 2 and day 3 colostrum samples which within themselves possessed comparable ash content. Findings reported by Klimes *et al.* (1986) and Tsioulpas *et al.* (2007) corroborate the findings in the current study. Without regard to the days of transition, the ash content of the colostrum samples of fourth lactation was significantly ($p \leq 0.05$) higher than the lactose content of colostrum samples of first and second lactation. The pH the colostrum samples from fifth lactation cows was significantly ($p \leq 0.05$) lower than other lactations. The latter among themselves possessed similar ($p > 0.05$) values. Irrespective of the different lactation numbers pH values increased significantly ($p \leq 0.05$) with every passing day post-partum upto day 3 post-partum. The day 1 postpartum colostrum samples had significantly ($p \leq 0.05$) lower pH value than day 2 and day 3 colostrum samples and between the latter two samples, the day 2 samples had significantly ($p \leq 0.05$) lower pH values compared to day 3 samples. Similar increase has been reported by Klimes *et al.* (1986) and Elfstrand *et al.* (2002).

The electrical conductivity of the colostrum samples, without regard to the days of transition possessed comparable values having no significant ($p > 0.05$) difference among different lactation numbers whatsoever. Irrespective of the different lactation numbers the day 1 postpartum colostrum samples had significantly ($p \leq 0.05$) higher values than day 2 and day 3 colostrum samples and between the latter two samples, the day 2 samples had significantly ($p \leq 0.05$) higher value compared to day 3 samples. The results at day 1 uphold the findings of Raimondo *et al.* (2009) and Bar *et al.* (2010). Without taking into consideration different lactation numbers, the total plate count (TPC) showed an increasing trend with the passage of post-partum period with values being significantly ($p \leq 0.05$) lower at day 1 followed by a significant ($p \leq 0.05$) increase at day 2 and further significant ($p \leq 0.05$) increase at day 3. The findings are close to the findings of Morill *et al.* (2012). Irrespective of the days of transition, the total plate count (TPC) of the colostrum samples from sixth lactation cows was significantly ($p \leq 0.05$) higher than other lactations. Lower values with regard to the major colostrum components in second lactation compared to preceding or succeeding lactations has also been reported by Quigley III *et al.* (1994) and Morill *et al.* (2012). The precise reason to explain the situation is currently not available however.

DOI 10.5455/ijlr.20190421025246

Conclusion

The animals in second lactation possessed lower values for various physico-chemical, compositional and microbiological characteristics than the animals in first and third or higher lactations.

Acknowledgement

I am highly thankful to my Advisor and whole staff of Division of LPT, F.V.Sc. & A.H. Shuhama, SKUAST-K for being with me during my research

References

1. Bar, E., Tiris, I., Sarbu, D., Iridon, C., Cchea, I. and Bratu, I. (2010). Full characterization of bovine colostrum, raw material for dietary supplements, its beneficial effect on the human immune system. *Food Technology*, 12, 63-67.
2. BenHeng, G. and ChengXiang, L. (1996). Chemical composition of bovine colostrum. *Journal of Northeast Agricultural University*, 3**(**1), 72-77.
3. Blum, J. (2006). Nutritional physiology of neonatal calves. *Journal of Animal Physiology and Animal Nutrition*, 90, 1–11.
4. Clark, D.G. and Wyatt, K. (1996). Colostrum, Life's First Food. Salt Lake City: CNR Publications.
5. Elfstrand, L., Lindmark-Mansson, H., Paulsson, M., Nyberg, L. and Akesson, B. (2002). Immunoglobulins, growth factors and growth hormone in bovine colostrum and the effects of processing. *International Dairy Journal*, 12, 879–887.
6. Foley, J.A. and Otterby, D.E. (1978). Availability, storage, treatment, composition, and feeding value of surplus colostrum: a review. *Journal of Dairy Science*, 61, 1033-1060.
7. Fox, P.F. and McSweeney, P.L.H. (2003). Advanced dairy chemistry in Vol. 1. Proteins (3rd edition partA). NewYork, NY, USA: Kluwer Academic/Plenum Publishers.
8. Fraga e Silva Raimondo, R., Brandespim, F.B., Prina, A.P.M. and Birgel Junior, E.H. (2009). Evaluation of the pH and electrical conductivity in milk from Jersey cows during the first month of lactation. *Semina: Ciencias Agrárias (Londrina)*, 30(2), 447-455.
9. Gapper, L.W., Copestake, D.E.J., Otter, D.E. and Indyk, H.E. (2007). Analysis of bovine immunoglobulin G in milk, colostrum and dietary supplements: *a review. Analytical and Bioanalytical Chemistry*, 389, 93–109.
10. Kehoe, S.I., Jayarao, B.M. and Heinrichs, A.J. (2007). A survey of bovine colostrum composition and colostrum management practices on Pennsylvania dairy farms. *Journal of Dairy Science*, 90, 4108-4116.
11. Kleinsmith, A. (2011). Scientific and medical research related to bovine colostrum, Its relationship and use in the treatment of disease in humans selected published abstracts. True bovine colostrum for the practitioner. Internet: downloaded from http://www.healthyhabitsusa.com/pdfs/colustrum.pdf.
12. Klimes, J., Jagos, P., Houda, J. and Gajdusek, S. (1986). Basic qualitative parameters of cow colostrum and their dependence on season and post-partum time. *Acta vet. Brno*, 55, 23-39.
13. Kume, S. and Tanabe, S. (1993). Effect of Parity on Colostral Mineral Concentrations of Holstein Cows and Value of Colostrum as a Mineral Source for Newborn Calves. *Journal of Dairy Science*, 76, 1654-1660.
14. Levieux, D. and Ollier, A. (1999). Bovine immunoglobulin G, beta-lactoglobulin, alpha- lactalbumin and serum albumin in colostrum and milk during the early post-partum period. *Journal of Dairy Research*, 66, 421–430.
15. Liu, G.L., Wang, J.Q., Bu, D.P., Cheng, J.B., Zhang, C.G., Wei, H.Y., Zhou, L.Y., Zhou, Z.F., Hu, H. and Dong, X.L. (2009). Factors affecting the transfer of immunoglobulin G1 into the milk of Holstein cows. *The Veterinary Journal*, 182, 79-85.

 DOI 10.5455/ijlr.20190421025246

16. McGee, M., Drennan, M.J. and Caffrey, P.J. (2006). Effect of age and nutrient restriction pre partum on beef suckler cow serum immunoglobulin concentrations, colostrum yield, composition and immunoglobulin concentration and immune status of their progeny. *Irish Journal of Agricultural and Food Research*, 45, 157–171.
17. Morin, D.E., Constable, P.D., Maunsell, F.P. and McCoy, G.C. (2001). Factors associated with colostral specific gravity in dairy cows. *Journal of Dairy Science*, 84, 937-943.
18. Morrill, K.M., Conrad, E., Lago, A., Campbell, J., Quigley, J. and Tyler, H. (2012). Nationwide evaluation of quality and composition of colostrum on dairy farms in the United States. *Journal of dairy sciences*, 95, 3997–4005.
19. Nazir, T., Pal, M.A., Baba, F.A., Manzoor, A., Sofi, A.S. and Ahmad, S.R. (2018). Effect of the Sex of New Born During Various Days of Transition Period on Various Physico-Chemical, Compositional and Microbiological Characteristics of Bovine Colostrum. *International Journal of Livestock Research*, 8(12), 233-246. doi: 10.5455/ijlr.20180507014059.
20. Ontsouka, C.E., Bruckmaier, R.M. and Blum, J.W. (2003). Fractionized milk composition during removal of colostrum and mature milk. *Journal of Dairy Science*, 86, 2005–2011.
21. Playford, R.J., Macdonald, C.E. and Johnson, W.S. (2000). Colostrum and milk-derived peptide growth factors for the treatment of gastrointestinal disorders. *American Journal of Clinical Nutrition*, 72, 5-14.
22. Quigley III, J.D., Martin, K.R., Dowlen, H.H., Wallis, L.B. and Lamar, K. (1994). Immunoglobulin concentration, specific gravity, and nitrogen fractions of colostrum from jersey cattle. *Journal of Dairy Sciences*, 77, 264-269.
23. Raducan, G.G., Acatincai, S., Cziszter, L.T., Tripon, I. and Baul S. (2013). Contributions to the Knowledge of Chemical Composition Evolution in Colostral Milk. *Animal Science and Biotechnologies*, 46(2), 322-324.
24. Sobczuk-Szul, M., Wielgosz-Groth, Z., Wroński, M. and Rzemieniewski, A. (2013). Changes in the bioactive protein concentrations in the bovine colostrum of Jersey and Polish Holstein–Friesian cows. *Turkish Journal of Veterinary and Animal Sciences*, 37, 43-49.
25. Tsioulpas, A., Grandison, A.S. and Lewis, M.J. (2007). Changes in physical properties of bovine milk from the colostrum period to early lactation. *Journal of Dairy Science*, 90, 5012-5017.
26. Verma, U., Singh, A., Shah, N., Yadav, H., Ghosh, A. and Kumar, S. (2018). Colostrum Immunomodulator and Health Promoter for Dairy Calves. *International Journal of Livestock Research*, 8(7), 14-20. doi: 10.5455/ijlr.20170819111616.
27. Wilson, J. (1997). Immune system breakthrough: Colostrum. *Journal of Longevity Research*, 3, 7–10.

DOI 10.5455/ijlr.20190421025246