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Effect of the age of cow through the transition period on various physico-chemical, compositional and microbiological characteristics of bovine colostrum

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Abstract
Colostrum samples were collected from the MLRI, SKUAST-Kashmir and various field locations during 2015-16 with the objective of finding out the relationship between the age of cow and quality characteristics of bovine colostrum. The cows from whom samples were collected were grouped into three different groups according to their ages, Group I – cows of 2-4 years of age; Group II – cows of 5-7 years of age; Group III – cows of 8-10 years of age. The specific gravity, fat, whey proteins, and total solids (1.042, 5.8%, 3.6%, 19.9% respectively) of the colostrum samples of group I cows was significantly ($p \leq 0.05$) lower compared to group II cows (1.047, 6.6%, 4.5%, 21.9% respectively). The total protein content of group I cows (8.5%) was significantly ($p \leq 0.05$) lower than both group II (9.8%) and group III (9.7%) cows which among themselves possessed comparable values for total protein. The ash content of the colostrum samples the group I cows (0.89%) showed significantly ($p \leq 0.05$) lower values compared to group III cows (1.02%) while the ash content of group II (0.91%) cows was comparable to both group I as well as group III cows. Casein protein, lactose, solids not fat, ash and electrical conductivity possessed comparable values having no significant ($p > 0.05$) difference among different age groups.

Keywords: Age, bovine-colostrum, post-partum, physico-chemical, quality

1. Introduction
There has been a consistent increase in the milk production owing to several breeding, feeding and management interventions that has prompted people to realize the vast potential lying in the establishment of organized dairy farming. Improvements such as lower age at first calving, reduction in inter-calving periods, increased conception rates and several other parameters of progress have resulted in an overall increase in yield of milk [27]. Milk is the liquid secretion from female mammary gland which has composition that is specific to particular species so as to meet the unique nutritional necessities of the offspring of that species. The composition of the secretion from mammary gland fluctuates during the whole lactation period as per the changing metabolic needs of the new born from birth till weaning [7]. Colostrum is defined, as the "secretion of the mammary gland produced immediately after parturition [17], "during the first 24 h after calving or through the first few days after birth" [29]. Composition of colostrum is different from the milk which is produced later in the lactation, indicating that the two materials have different biological function. Bovine colostrum has higher total solids content as compared to bovine milk (27.6%, w/w, versus 12.3%, w/w), because of higher protein content (14.9% versus 2.8%) and slightly higher fat content (6.7% versus 4.4%), but is low in lactose content (2.5% versus 4.0%) [10, 13]. The first portion of the colostrum obtained immediately after calving has highest concentration of most of the ingredients especially those of growth factors and immunoglobulins, which decrease rapidly thereafter [5, 24]. Immunoglobulins constitute more than 50% of the total amount of proteins present in colostrum, which encompass almost all antibodies, present in maternal blood. IgG1 constitutes about 90% of colostrum Ig [12]. On the contrary, the colostrum contains lower levels of lactose and casein as compared to milk [22]. Many biologically active substances like IgG, somatotropin, prolactin, insulin and glucagon enter colostrum directly from blood while others are produced locally in the udder from lactocytes and stroma.

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% [30]. 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 [6]. Colostrum samples were collected from the MLRI, SKUAST-Kashmir and various field locations during 2015-16 with the objective of finding out the relationship between the age of cow and quality characteristics of bovine colostrum.

2. Materials and Methods

2.1 Source of raw materials

2.1.1 Source of colostrum

Colostrum samples were collected from the MLRI, SKUAST-Kashmir and various field locations during 2015-16. 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:

1. Specific gravity (AOAC, 2000) [1]
2. Total protein (AOAC, 2000) [1]
3. Casein protein (AOAC, 2000) [1]
4. Whey protein (AOAC, 2000) [1]
5. Fat (AOAC, 2000) [1]
6. Lactose (AOAC, 2000)
7. Ash (AOAC, 2000) [1]
8. Total solids (AOAC, 2000) [1]
9. SNF (AOAC, 2000) [1]
10. pH (AOAC, 2000) [1]
11. Electrical conductivity (AOAC, 2000) [1]
12. Total plate count (APHA, 2004) [2]

2.1.2 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.).

2.2 Preparation of samples

2.2.1 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.

2.3 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.

2.3.1 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.

2.3.2 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 calculated to arrive at the correct specific gravity

2.3.3 Titratable acidity of colostrum

A 10ml quantity of thoroughly mixed colostrum samples were taken in a conical flask with the help of dry pipette. To this few drops of phenolphthalein indicator were added. Then the colostrum was carefully titrated against 0.1N sodium hydroxide till faint pink colour appeared and persisted for 15 seconds. The volume of 0.1N sodium hydroxide used was recorded and titratable acidity (expressed as a percentage of lactic acid) was calculated as per formula given below [1]:

$$\text{Percent titratable acidity} = \frac{\text{No. of ml of 0.1 N NaOH used} \times 0.009}{\text{Weight of sample in grams}} \times 100$$

2.3.4 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. Equipments") into the sample after proper calibration of instrument [1]. Two or three readings were taken for each sample and average electric conductivity was calculated.

2.4 Proximate composition

The colostrum samples were analyzed for determination of various physico-chemical parameters using the standard procedures of Association of Official Analytical Chemists [1]. Brief description of the methods is outlined below:

2.4.1 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 (AOAC, 2000) [1].

Calculation:

% 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)

2.4.2 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.

SNF (%) = TS% - Fat%

2.4.3 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 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.

2.4.4 Protein

Micro-kjeldahl method was followed for determination of protein content of colostrum [1]. Micro-kjeldahl distillation apparatus was used for distillation of digested sample. About two grams of colostrum sample in duplicate were taken in kjeldahl flask and digested with 20 ml of concentrated sulphuric acid. A small amount of digestion mixture (sodium sulphate and copper sulphate in the ratio of 95:5) was added to aid digestion. After all the contents were digested, the digested samples were transferred to 250 ml volumetric flask and the volume was made up to the mark, with rinsing of kjeldahl flask, with distilled water. From the volume of 250 ml, 10 ml was taken into micro-kjeldahl assembly along with the 10 ml of 40 percent sodium hydroxide for distillation. Upon distillation the ammonia was liberated which was collected in 4 percent boric acid solution. The titration of the collected ammonia was carried out against N/50 sulphuric acid to get amount of nitrogen present in the sample.

Calculation

$$\text{Percent protein (g protein/100 gm of sample)} = \frac{B \times 0.00028 \times 250 \times 100 \times 6.38}{W \times V}$$

Where,
B burette reading of N/ 50 sulphuric acid
250 volume of aliquot
W weight of sample
V volume of aliquot used for distillation
6.38 Empirical factor (for milk protein)
0.00028 factor for N/50 sulphuric acid used

2.4.5 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 [1].

Calculation

Ash percent = [W1 – W2/ W2 – W] X 100
Where,
W = weight of empty dried crucible (g)
W1 = weight of crucible + sample after ashing (g)
W2 = weight of sample (g)

2.4.6 Lactose

Lane-Eynon Oxidation–Reduction Reaction method was followed for determination of lactose content of colostrum samples [1]. 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 percent 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.

Calculation

Lactose (%) = W/V x 250 x 100/25 x 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

2.5 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 [2].

2.5.1 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).

2.5.2 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 [2]:

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

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

2.6 Sensory appraisal
The sensory evaluation of the fermented colostrum product was carried out by a trained and semi-trained experienced panel consisting of scientists of LPT Division and PG students of F.V.Sc. & A.H, SKUAST-K. The panelists evaluated the coded samples of fermented colostrum product for various sensory attributes viz., appearance, flavour, body and texture and overall acceptability as per 9 point Hedonic scale where 9 denoted extremely desirable and 1 denoted extremely poor as given in score sheet [23].

3. Statistical analysis
The data obtained from duplicate samples were averaged and the data so generated were analyzed statistically in a computer using SPSS 20 software package. The analysis of variance of group mean was computed and significance of means tested by using Least Significant Difference test at 5 percent 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.

4. Results and Discussion
In this study the data was generated using the colostrum obtained from cows of different ages. The cows were then grouped into three different groups viz., group I, group II and group III according to their ages as mentioned below

Group I – cows of 2-4 years of age
Group II – cows of 5-7 years of age
Group III – cows of 8-10 years of age

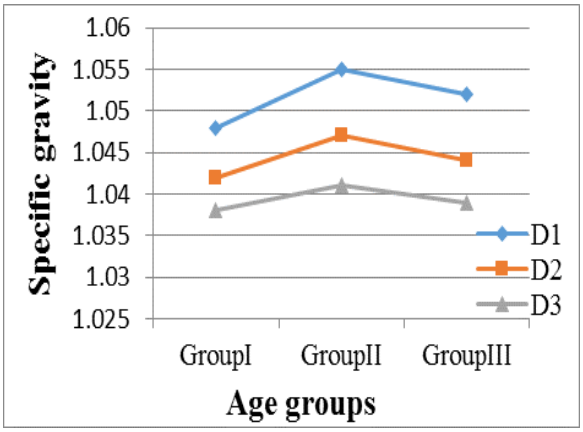
The data pertinent to the study related to the effect of the age of the cow during transition period on various physico-chemical, compositional and microbiological characteristics of bovine colostrum have been set down in Table 1 and graphically shown in Figs. 1 and 2. As signified by the result; regardless of the age of the cow, 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 3 samples. The results agree favorably with those of Foley and Otterby [9], Quigley III *et al.* [25], Morin *et al.* [20] and Sobczuk-Szul *et al.* [28]. Without regard to the days of transition, the specific gravity of the colostrum samples of group I (2-4 yrs.) was significantly ($p \leq 0.05$) lower than group II (5-7 yrs.) colostrum samples. The results, in general are in agreement with those of Kume and Tanabe [16]. The fat content of the colostrum samples during various days postpartum decreased significantly ($p \leq 0.05$) from highest value at day 1 to the lowest value at day 3. The values are similar to the values reported by Foley and Otterby [9], Klimes *et al.* [15] and Raducan *et al.* [26]. As far as the fat values of the colostrum samples from different age groups are concerned, the group I cows showed significantly ($p \leq 0.05$) lower values compared to group II cows. The findings are parallel to the findings as reported by McGee *et al.* [19]. 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 [9], Klimes *et al.* [15], Elfstrand *et al.* [8] and Raducan *et al.* [26]. Without taking the days of transition into account, the total protein content of group I cows was significantly ($p \leq 0.05$) lower than both group II and group III cows.

Table 1: Effect of the age of the cow through the transition period on various physico-chemical, compositional and microbiological characteristics of bovine colostrum (Mean ± S.E.)

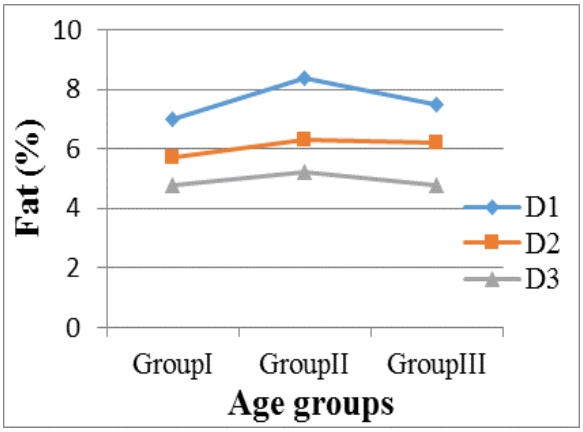
Days postpartum	Age of the cow in years			Overall mean
	Group I (2-4 yr)	Group II (5-7 yr)	Group III (8-10 yr)	
Specific gravity				
D1	1.048±0.002	1.055±0.003	1.052±0.003	1.052±0.002[1]
D2	1.042±0.002	1.047±0.002	1.044±0.002	1.044±0.001[2]
D3	1.038±0.001	1.041±0.001	1.039±0.002	1.039±0.001[3]
Overall mean	1.042±0.001[a]	1.047±0.002[b]	1.045±0.002[ab]	1.045±0.001
Fat (%)				
D1	7.0±0.43	8.4±0.32	7.5±0.57	7.6±0.27[1]
D2	5.7±0.32	6.3±0.19	6.2±0.46	6.1±0.20[2]
D3	4.8±0.31	5.2±0.13	4.8±0.32	4.9±0.15[3]
Overall mean	5.8±0.26[a]	6.6±0.26[b]	6.2±0.32[ab]	6.2±0.16
Total protein (%)				
D1	10.4±0.58	12.6±0.70	11.8±1.08	11.6±0.48[1]
D2	8.3±0.35	9.4±0.56	9.7±0.85	9.1±0.36[2]
D3	7.0±0.25	7.3±0.37	7.7±0.49	7.3±0.22[3]
Overall mean	8.5±0.34[a]	9.8±0.49[b]	9.7±0.56[b]	9.3±0.28

Casein protein (%)				
D1	3.1±0.19	3.6±0.22	3.4±0.38	3.3±0.16[1]
D2	6.3±0.23	7.0±0.43	7.3±0.62	6.9±0.26[2]
D3	5.4±0.18	5.6±0.30	5.9±0.37	5.6±0.17[3]
Overall mean	4.9±0.27[a]	5.4±0.31[a]	5.5±0.39[a]	5.3±0.19
Whey protein (%)				
D1	7.3±0.42	9.0±0.54	8.4±0.75	8.2±0.35[1]
D2	1.9±0.13	2.4±0.17	2.4±0.24	2.2±0.11[2]
D3	1.7±0.08	2.2±0.20	1.8±0.14	1.7±0.06[2]
Overall mean	3.6±0.48[a]	4.5±0.60[b]	4.2±0.59[ab]	4.1±0.32
Lactose (%)				
D1	2.7±0.59	2.7±0.05	2.7±0.04	2.7±0.03[1]
D2	3.4±0.12	3.4±0.08	3.3±0.09	3.4±0.06[2]
D3	3.8±0.14	3.9±0.11	3.6±0.11	3.8±0.07[3]
Overall mean	3.3±0.10[a]	3.4±0.10[a]	3.2±0.08[a]	3.3±0.05
Total solids (%)				
D1	23.3±1.01	26.5±0.99	25.2±1.7	24.9±0.75[1]
D2	19.2±0.57	21.2±0.70	20.9±1.39	20.5±0.56[2]
D3	17.1±0.46	18.0±0.44	17.6±1.03	17.6±0.39[3]
Overall mean	19.9±0.61[a]	21.9±0.74[b]	21.2±0.96[ab]	21.0±0.45
Solids not fat (%)				
D1	16.2±0.65	18.1±0.76	17.8±1.18	17.4±0.52[1]
D2	13.6±0.39	14.9±0.57	14.8±0.93	14.4±0.39[2]
D3	12.3±0.30	12.9±0.40	12.8±0.74	12.6±0.29[3]
Overall mean	14.0±0.39[a]	15.3±0.51[a]	15.2±0.65[a]	14.8±0.31
Ash (%)				
D1	1.03±0.05	1.08±0.09	1.33±0.15	1.14±0.06[1]
D2	0.87±0.02	0.87±0.04	0.91±0.04	0.88±0.11[2]
D3	0.78±0.02	0.79±0.03	0.81±0.02	0.79±0.01[2]
Overall mean	0.89±0.03[a]	0.91±0.04[ab]	1.02±0.06[a]	0.94±0.03
pH				
D1	6.37±0.02	6.38±0.02	6.38±0.02	6.38±0.01[1]
D2	6.44±0.02	6.45±0.02	6.45±0.03	6.45±0.01[2]
D3	6.51±0.02	6.54±0.03	6.55±0.03	6.53±0.02[3]
Overall mean	6.44±0.02[a]	6.45±0.02[a]	6.46±0.02[a]	6.5±0.01
Electrical conductivity (mScm^{-1})				
D1	5.5±0.21	5.6±0.15	**5.6±0.20**	5.6±0.11[1]
D2	4.8±0.23	4.7±0.19	4.8±0.23	4.8±0.12[2]
D3	4.2±0.12	4.3±0.14	4.4±0.15	4.3±0.08[3]
Overall mean	4.8±0.14[a]	4.9±0.14[a]	4.9±0.14[a]	4.9±0.08
Total plate count (log$_{10}$cfu/ml)				
D1	4.7±0.08	4.6±0.04	4.7±0.04	4.6±0.03[1]
D2	4.8±0.05	4.7±0.03	4.8±0.03	4.8±0.02[2]
D3	4.9±0.05	4.8±0.02	4.9±0.04	4.9±0.02[3]
Overall mean	4.8±0.04[a]	4.7±0.03[b]	4.8±0.03[a]	4.8±0.02

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



(a)



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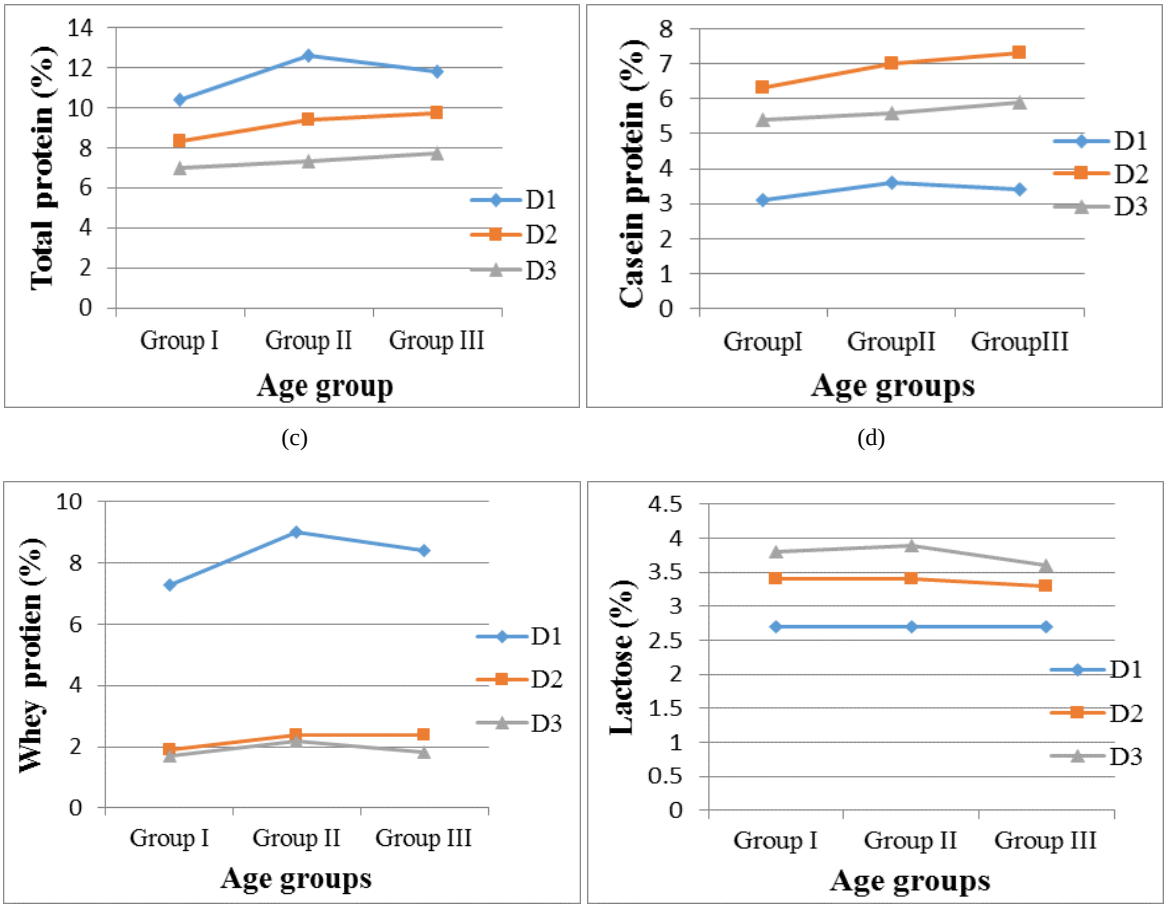
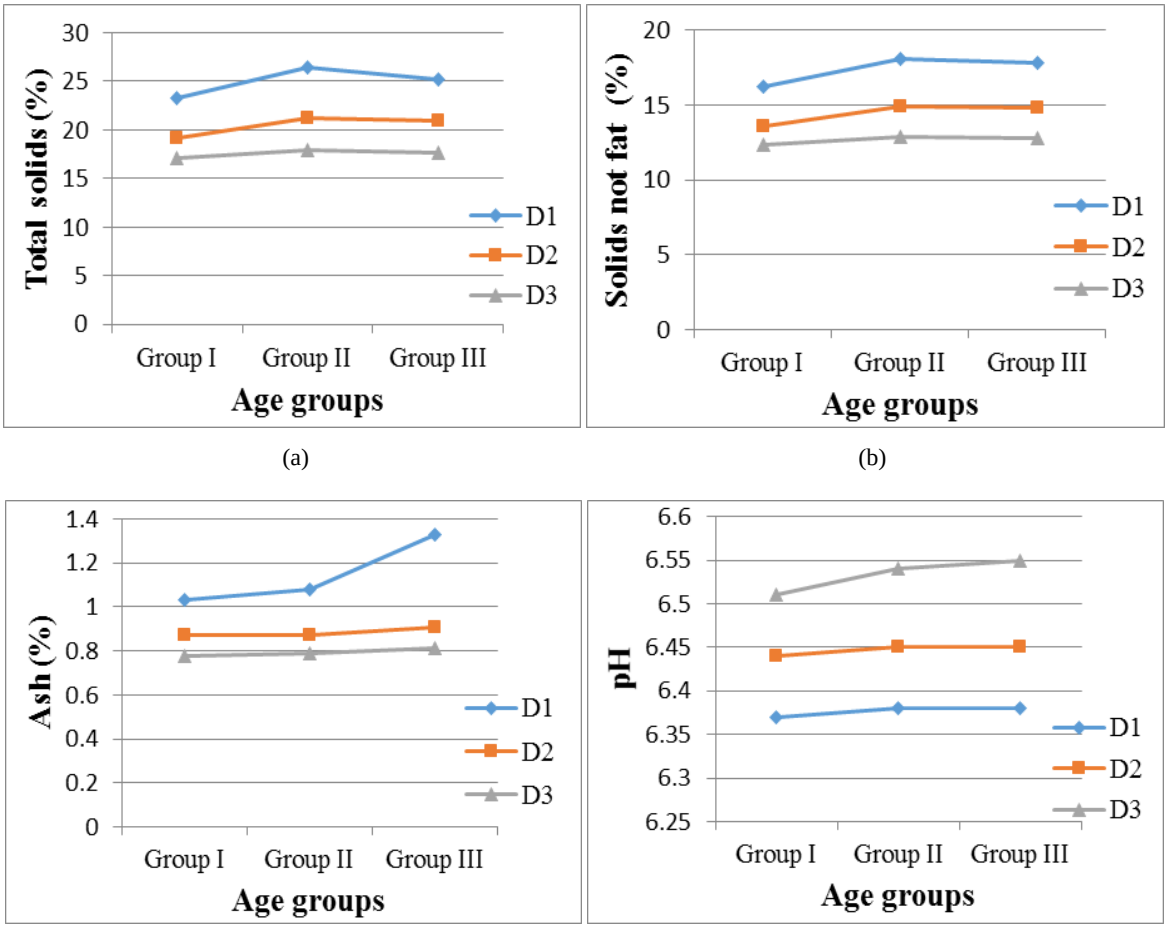


(c) (d)

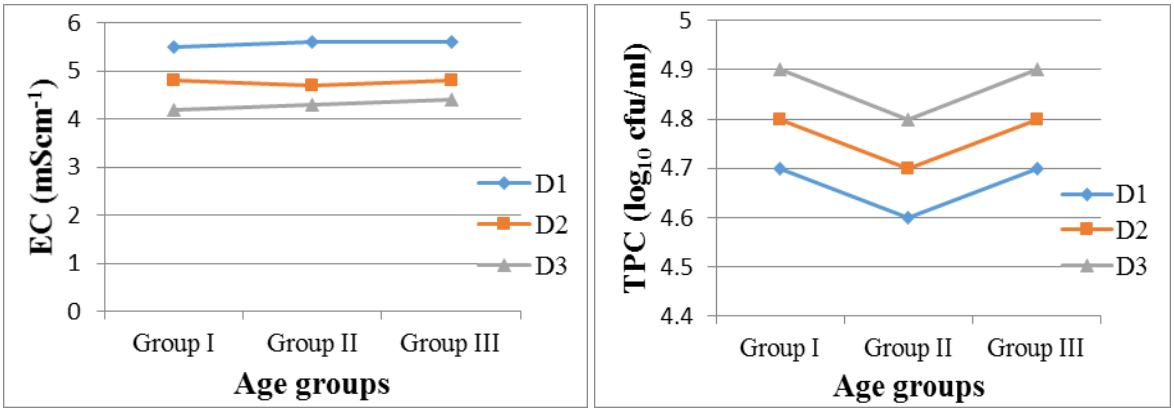
(e) (f)

Fig 1: Effect of the age of the cow through the transition period on specific gravity (a), fat (b), total protein (c), casein protein (d), whey protein (e) and lactose (f) of bovine colostrum



(a) (b)

(c) (d)



(e) (f)

Fig 2: Effect of the age of the cow through the transition period on total solids (a), solids not fat (b), ash (c), pH (d), electrical conductivity (e) and total plate count (f) of bovine colostrum

The results do not differ from the findings of Kume and Tanabe [16]. The casein protein values 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 [4]. Without regard to the days of transition, the Casein protein of the colostrum samples among different age groups was similar. The whey protein content of the colostrum samples during various days 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.* [15] and Benheng and Chengxiang [4]. As far as the whey protein values of the colostrum samples from different age groups are concerned, the group I cows showed significantly ($p \leq 0.05$) lower values compared to group II cows. The results uphold the findings of McGee *et al.* [19], Liu *et al.* [18] and Morrill *et al.* [21]. Lactose, on the other hand increased 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 each other. These results are in agreement with the findings of Foley and Otterby [9], Benheng and Chengxiang [4], Elfstrand *et al.* [8] and Kleinsmith [14]. Irrespective of the days of transition the lactose content of colostrum samples among different age groups did not elicit any significant variation. Total solids of the colostrum samples during various days postpartum showed a declining trend with values being significantly ($p \leq 0.05$) different from one another irrespective of the age of the cow under study. Similar trend has been reported by Foley and Otterby [9], Klimes *et al.* [15] and Raducan *et al.* [26]. As far as the Total solids value of the colostrum samples from different age groups are concerned, the group I cows showed significantly ($p \leq 0.05$) lower values compared to group II cows. Without acknowledging different age groups, 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 thereby putting on show a clear cut trend of transition from a higher solids not fat towards normally lower solids not fat as the transition period passed on. Somewhat similar trend has been reported by Raducan *et al.* [26]. As far as the solids not fat value of the colostrum samples from cows of different age groups are concerned, they did not show any significant ($p > 0.05$) difference among them. Keeping aside different age groups, 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. Similar findings have been reported by Klimes *et al.* [15] and Tsioulpas *et al.* [29]. Without regard to the days of transition, the ash content of the colostrum samples the group I cows showed significantly ($p \leq 0.05$) lower values compared to group III cows. The pH of the colostrum samples among different age groups was found to possess no significant ($p > 0.05$) variation among themselves whatsoever. Without considering different age groups 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.* [15] and Elfstrand *et al.* [8]. 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 various age groups under study. Irrespective of the different age groups, 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 Fraga e Silva Raimondo *et al.* [11] and Bar *et al.* [3]. Without looking upon at the days of transition, the total plate count (TPC) of group II cows was significantly ($p \leq 0.05$) lower than both group I and group III cows. Irrespective of the different age groups 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 Morrill *et al.* [21].

5. Conclusion

The cows of age group II had highest values for most of the compositional and physicochemical characteristics of bovine colostrum whereas the cows of age group I possessed lowest values except for casein protein, ash and pH, which was highest in group III cows.

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