Study on the Effect of the Breed during Post-Partum Transition Period on Various Physico-Chemical, Compositional and Microbiological Characteristics of Bovine Colostrum

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ABSTRACT
The current investigation was undertaken with the aim of studying the effect of breed of the animal on various physico-chemical, compositional and microbiological characteristics of bovine colostrum. While studying the effect of breed of the animal on various physico-chemical, compositional and microbiological characteristics of colostrum, it was found that the specific gravity, fat, total protein, casein protein, whey proteins, Lactose, total solids and solids not fat of the colostrum samples from local non-descript animals were significantly (p ≤ 0.05) lower compared to all other animal sources (breeds) under study. The fat content of Jersey cross (fi) [Jersey cross under field conditions] was significantly (p ≤ 0.05) higher than Jersey cross (fa) [Jersey cross under farm conditions]. Total protein content of Jersey and Jersey cross (fi) were found to be comparable however both these samples were found to be possessing significantly (p ≤ 0.05) higher values than Jersey cross (fa). Casein protein of Jersey and Jersey cross (fi) was found to be comparable however both these samples were found to be possessing significantly (p ≤ 0.05) higher values than Jersey cross (fa). Lactose content of Jersey was significantly (p ≤ 0.05) higher than Jersey cross (fi), Total solids content of Jersey cross (fi) was significantly (p ≤ 0.05) higher than Jersey cross (fa). Jersey cross (fi) possessed significantly (p ≤ 0.05) higher solids not fat content than Jersey cross (fa) and the values were found to be comparable with Jersey colostrum samples. The pH values of colostrum samples of Jersey were seen to be significantly (p ≤ 0.05) higher than all other sources of colostrum viz. Local, Jersey cross (fa) and Jersey cross (fi). Amongst the latter three, the values were found to be comparable. The ash, electrical conductivity and total plate count (TPC) of the colostrum samples of the animal sources under study were found to be possessing comparable values having no significant (p > 0.05) difference among themselves whatsoever.

Key words: Bovine colostrum, Breed, Post-partum, Quality, Transition period.

INTRODUCTION
There has been a steady increase in the Milk production owing to numerous breeding, feeding and managerial interventions that has encouraged 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. Colostrum is defined, as the secretion of the mammary gland produced immediately after parturition (Levieux and Ollier, 1999), during the first 24 h after calving or through the first few days after birth (Tsioulpas et al., 2007). Colostrum is of therapeutic use in treatment of variety of health conditions, including gastrointestinal disorders, respiratory tract disorders, and tissue repair (Li and Aluko, 2006). Colostrum could be used for the treatment of intestinal inflammation instigated by the injurious effects of NSAID, it also has therapeutic potential for other ulcerative conditions in the bowel (Cairangzhuoma et al., 2013). Colostrum is emerging as the most potent natural immune booster for human beings. Colostrum has the ability to prevent from bacteria and viruses, and to improve the gastrointestinal and body condition (Houser et al., 2008). 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

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even reverses aging. Bovine colostrum has many purported health benefits. Keeping in view the above versatility of colostrum along with its immense food, nutritional and economic value, the present study is envisioned to help utilizing the surplus colostrum effectively for mitigating the problems such as food, nutritional insecurity and prevention of spoilage of a salubrious product: With this background the current work was undertaken with the aim of studying the effect of breed of the animal on various physico-chemical, compositional and microbiological characteristics of bovine colostrum.

**MATERIALS AND METHODS**

Colostrum samples of different breeds 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:

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)

**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 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**

In this study the data were generated using the colostrum obtained from four different animal sources (breeds) viz., Local, Jersey, Jersey cross under farm conditions [Jersey cross (fa)] and Jersey cross under field conditions [Jersey cross (fi)]. The samples were obtained from each source at three consecutive days postpartum during the transition period from colostrum to milk. The data pertinent to various characteristics of colostrum obtained from afore said sources is delineated in Table 1 and graphically presented in Fig 1 and 2. The perusal of the data from the table under discussion reveals that there was no significant interaction observed between the days of transition postpartum and breed of the animal. Irrespective of various sources of colostrum (breeds), the day 1 postpartum colostrum samples had significantly (p ≤ 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 ≤ 0.05) higher specific gravity compared to day three samples, thereby exhibiting a explicit trend of transition from a higher specific gravity towards normally lower specific gravity as the transition period elapsed. These results agree favourably with those reported by Foley and Otterby (1978), Quigley III et al. (1994), Morin et al. (2001) and Sobczuk-Szul et al. (2013). Without taking into consideration the days of transition, the specific gravity of the colostrum samples from Jersey and Jersey cross animals was significantly (p ≤ 0.05) higher than local non-descript animals. Similar findings have been reported by Morin et al. (2001) and Sobczuk-Szul et al. (2013). Who demonstrated the Jersey colostrum having comparatively higher density compared to local polish HF breed of cows. The fat content of the colostrum samples during various periods postpartum showed a declining trend with values being significantly (p ≤ 0.05) different from one another irrespective of the breed 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 breeds are concerned, the fat content of the colostrum samples from Jersey and Jersey cross animals were significantly (p ≤ 0.05) higher than local non-descript animals. Similar findings have been put across by Ibrahim (1990). The colostrum samples of Jersey cross (fa) [Jersey cross under farm conditions] and Jersey cross (fi) [Jersey cross under field conditions] were found to be significantly different in that Jersey cross (fi) possessed significantly (p ≤ 0.05) higher values than Jersey cross (fa) and it possibly seems to be attributable to the difference in the yield of milk as propounded by Szulc and Zachwieja (1998) and Sobczuk-Szul et al. (2013) who contend that the low yielding dairy cattle breeds and beef breeds have higher concentrations of colostrum components.

Total protein content of the colostrum during the transition period postpartum declined progressively with values at each day under study being significantly (p ≤ 0.05) different from one another. Similar results are reported by Foley and Otterby (1978), Klimes et al. (1986), Efstrand et al. (2002) and Raducan et al. (2013). Regardless of the days of transition, the total protein content of the colostrum samples from Jersey and Jersey cross animals were significantly (p ≤ 0.05) higher than local non-descript animals. The results are almost parallel to the findings
### Table 1: Effect of the breed and transition period on various physico-chemical, compositional and microbiological characteristics of bovine colostrum (Mean ± S.E.).

| Days postpartum | Breed of the animal | Overall mean |
|-----------------|----------------------|--------------|
|                 | Local                | Jersey       | Jersey cross (fa) | Jersey cross (fi) |
| Specific gravity|                      |              |                  |                  |
| D1              | 1.042±0.001         | 1.048±0.002  | 1.053±0.002      | 1.056±0.003      |
| D2              | 1.037±0.001         | 1.043±0.003  | 1.046±0.002      | 1.047±0.002      |
| Overall mean    | 1.038±0.001*        | 1.044±0.001* | 1.046±0.001*     | 1.047±0.002*     |
| Fat (%)         |                      |              |                  |                  |
| D1              | 5.4±0.25            | 8.0±0.80     | 7.8±0.34         | 8.7±0.31         |
| D2              | 4.5±0.20            | 6.6±0.26     | 6.0±0.23         | 6.9±0.29         |
| D3              | 3.9±0.26            | 5.7±0.12     | 5.0±0.23         | 5.4±0.18         |
| Overall mean    | 4.6±0.20*           | 6.8±0.42bc   | 6.2±0.24b        | 7.0±0.29bc       |
| Total protein (%)|                     |              |                  |                  |
| D1              | 8.4±0.55            | 13.3±0.41    | 11.1±0.61        | 13.6±0.78        |
| D2              | 6.9±0.42            | 9.8±0.32     | 8.6±0.38         | 11.0±0.67        |
| D3              | 6.3±0.35            | 7.9±0.34     | 7.0±0.31         | 8.2±0.38         |
| Overall mean    | 7.2±0.33*           | 10.3±0.82bc  | 8.9±0.36bc       | 10.9±0.54bc      |
| Casein protein (%)|                    |              |                  |                  |
| D1              | 2.5±0.28            | 4.2±0.17     | 3.1±0.19         | 4.0±0.28         |
| D2              | 5.4±0.33            | 7.3±0.58     | 6.5±0.27         | 8.1±0.52         |
| D3              | 4.9±0.27            | 5.9±0.46     | 5.4±0.23         | 6.3±0.29         |
| Overall mean    | 4.3±0.34*           | 5.8±0.50     | 5.0±0.26         | 6.1±0.38         |
| Whey protein (%)|                      |              |                  |                  |
| D1              | 5.9±0.30±1          | 9.2±0.25bc   | 8.0±0.46bc       | 9.7±0.61±1       |
| D2              | 1.6±0.09±2          | 2.6±0.27±2   | 2.1±0.14±2       | 2.8±0.18±2       |
| D3              | 1.4±0.08±3          | 2.0±0.13±2   | 1.6±0.09±2       | 1.9±0.10±2       |
| Overall mean    | 3.0±0.52            | 4.6±1.16     | 3.9±0.48         | 4.8±0.68         |
| Lactose (%)     |                      |              |                  |                  |
| D1              | 2.6±0.08            | 3.0±0.02     | 2.7±0.03         | 2.7±0.05         |
| D2              | 3.0±0.16            | 3.6±0.19     | 3.5±0.06         | 3.4±0.08         |
| D3              | 3.3±0.18            | 4.0±0.23     | 4.0±0.07         | 3.8±0.10         |
| Overall mean    | 3.0±0.10*           | 3.5±0.18*    | 3.4±0.08*        | 3.3±0.10*        |
| Total solids (%)|                      |              |                  |                  |
| D1              | 20.0±1.03           | 27.7±0.88    | 24.6±0.99        | 27.7±1.22        |
| D2              | 16.5±0.81           | 21.3±0.67    | 20.1±0.56        | 23.1±0.95        |
| D3              | 14.6±0.68           | 18.3±0.67    | 17.6±0.44        | 19.2±0.61        |
| Overall mean    | 17.0±0.72*          | 22.4±1.43bc  | 20.8±0.60        | 23.3±0.84        |
| Solids not fat (%)|                    |              |                  |                  |
| D1              | 14.6±0.95           | 19.6±0.73    | 16.9±0.66        | 19.0±0.97        |
| D2              | 12.0±0.65           | 14.7±0.91    | 14.2±0.43        | 16.2±0.69        |
| D3              | 10.6±0.47           | 12.7±0.78    | 12.7±0.35        | 13.8±0.46        |
| Overall mean    | 12.4±0.56*          | 15.7±1.11bc  | 14.6±0.39bc      | 16.4±0.57bc      |
| Ash (%)         |                      |              |                  |                  |
| D1              | 1.05±0.09           | 1.02±0.04    | 1.1±0.05         | 1.3±0.18         |
| D2              | 0.86±0.04           | 0.87±0.02    | 0.89±0.02        | 0.90±0.06        |
| D3              | 0.79±0.04           | 0.77±0.04    | 0.81±0.02        | 0.79±0.04        |
| Overall mean    | 0.90±0.04*          | 0.89±0.04*   | 0.93±0.03*       | 1.00±0.07*       |
| pH              |                      |              |                  |                  |
| D1              | 6.38±0.03           | 6.44±0.01    | 6.37±0.01        | 6.37±0.02        |
| D2              | 6.43±0.03           | 6.56±0.03    | 6.44±0.02        | 6.43±0.02        |
| D3              | 6.52±0.03           | 6.65±0.03    | 6.53±0.03        | 6.51±0.02        |
| Overall mean    | 6.44±0.02*          | 6.55±0.03b   | 6.44±0.02a       | 6.44±0.02a       |

Table 1: Continue.....
Table 1: Study on the Effect of the Breed during Post-Partum Transition Period on Various Physico-Chemical, Compositional...

| Days postpartum | Breed of the animal | Overall mean |
|-----------------|---------------------|--------------|
|                 | Local   | Jersey | Jersey cross (fa) | Jersey cross (fi) |            |
| Electrical conductivity (mScm⁻¹) |         |         |         |         |            |
| D1              | 5.5±0.22 | 5.7±0.33 | 5.5±0.20 | 5.7±0.15 | 5.6±0.11¹ |
| D2              | 4.5±0.22 | 5.0±0.00 | 4.9±0.21 | 4.8±0.25 | 4.8±0.12² |
| D3              | 4.2±0.17 | 4.3±0.03 | 4.2±0.11 | 4.4±0.16 | 4.3±0.08³ |
| Overall mean    | 4.7±0.18* | 5.0±0.24* | 4.9±0.13* | 5.0±0.15* | 4.9±0.08 |

Total plate count (log₁₀ cfu/ml)

| Days postpartum | Breed of the animal | Overall mean |
|-----------------|---------------------|--------------|
|                 | Local   | Jersey | Jersey cross (fa) | Jersey cross (fi) |            |
| D1              | 4.6±0.09 | 4.7±0.09 | 4.7±0.06 | 4.6±0.05 | 4.6±0.03¹ |
| D2              | 4.8±0.07 | 4.8±0.09 | 4.8±0.04 | 4.7±0.03 | 4.8±0.02² |
| D3              | 4.9±0.08 | 4.9±0.05 | 4.9±0.04 | 4.8±0.02 | 4.9±0.02³ |
| Overall mean    | 4.7±0.05* | 4.8±0.05* | 4.8±0.03* | 4.7±0.03* | 4.8±0.02 |

Fig 1: Effect of the breed during postpartum transition period on specific gravity (a), fat (b), total protein (c), casein protein (d), whey protein (e) and lactose (f) of bovine colostrum.
Fig 2: Effect of the breed during postpartum 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.

reported by Ibrahim et al. (1990) and Csapo et al. (2011). The total protein values of Jersey and Jersey cross (fi) were found to be comparable, however, both these samples were found to be possessing significantly ($p \leq 0.05$) higher values than Jersey cross (fa). Needless to elucidate the variation being as a result of difference in the yield as substantiated above. Upon examining the casein protein values of the colostrum samples the values of casein protein on day 1 were significantly ($p \leq 0.05$) lower than day 2 and day 3 while the values at day 2 were significantly ($p \leq 0.05$) higher than day 3. Similar trend has been reported by Benheng and Chengxiang (1996). Irrespective of the days of transition, the casein protein content of colostrum samples of local non-descript animals was seen to be significantly ($p \leq 0.05$) lower than all other sources of colostrum viz., Jersey, Jersey cross (fa) and Jersey cross (fi). Amongst the latter three, the values of Jersey and Jersey cross (fi) were found to be similar, however, both these samples were found to possess significantly ($p \leq 0.05$) higher values than Jersey cross (fa). Upon analysing whey protein content of the colostrum samples from various breeds during the varying periods of transition, a significant interaction was found between the two variables under study. While comparing the values of whey protein content of the colostrum samples from different breeds, it was noticed that at day 1 postpartum, the values were significantly ($p \leq 0.05$) lower in case of local compared to all other three sources of colostrum viz., Jersey, Jersey cross (fa) and Jersey cross (fi). Amongst the latter three sources, the values of Jersey were found to be comparable with both the Jersey cross (fa) as well as Jersey cross (fi),...
both of which differed significantly from each other with Jersey cross (fi) possessing significantly ($p \leq 0.05$) higher value than Jersey cross (fa). At day 2 the values of all the colostrum samples were found to be comparable except Jersey cross (fi) differing significantly ($p \leq 0.05$) from local non-descript source of colostrum, in that the former exhibited higher values. At day 3, there was no significant difference observed within the means. Within the breeds there was a uniformly similar 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. Lactose showed an opposite trend and 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 (1978), Benheng and Chengxiang (1996), Elfstrand et al. (2002) and Kleinsmith (2011). Irrespective of the days of transition, the lactose content of colostrum samples of local non-descript animals was seen to be significantly ($p \leq 0.05$) lower than all other sources of colostrum viz., Jersey, Jersey cross (fa) and Jersey cross (fl). The results uphold the findings of Ibrahim et al. (1990). The samples of Jersey had significantly ($p \leq 0.05$) higher values than Jersey cross (fl). Total solids content of the colostrum samples during various periods postpartum showed a diminishing trend with values being significantly ($p \leq 0.05$) different from one another irrespective of the breed 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 breeds is concerned, total solids of the colostrum samples from Jersey and Jersey cross animals were significantly ($p \leq 0.05$) higher than local non-descript animals. Similar findings have been reported by Csapo et al. (2011). The colostrum samples of Jersey cross (fl) possessed significantly ($p \leq 0.05$) higher values than Jersey cross (fa). Irrespective of the various sources of colostrum (breeds), 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 manifest trend of shift from a higher solids not fat towards normally lower solids not fat as the transition period went through. These results corroborate the findings of Raducan et al. (2013). Taking into consideration the solids not fat values of the colostrum samples from different breeds, the local non-descript animal sources showed significantly ($p \leq 0.05$) lower values compared to all other sources of colostrum, however, the colostrum samples of Jersey cross (fa) and Jersey cross (fl) were significantly ($p \leq 0.05$) different in that Jersey cross (fl) possessed significantly ($p \leq 0.05$) higher values than Jersey cross (fa). Regardless of the various sources of colostrum (breeds), the day 1 postpartum colostrum samples had significantly ($p \leq 0.05$) higher ash content than day 2 and day 3 colostrum samples which among themselves had comparable ash content. Similar findings have been reported by Klimes et al. (1986) and Tsioulpas et al. (2007). Without regard to the days of transition, the ash content of the colostrum samples of the animal sources under study possessed analogous values having no significant difference among themselves whatsoever. pH of the colostrum samples under study 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). Irrespective of the days of transition, the pH values of colostrum samples of Jersey were seen to be significantly ($p \leq 0.05$) higher than all other sources of colostrum viz., Local, Jersey cross (fa) and Jersey cross (fl). The difference could possibly be a result of the variation in the composition that has reflected the change in pH. Without regard to the days of transition, the electrical conductivity of the colostrum samples of the animal sources under study was found to be possessing comparable values having no significant ($p > 0.05$) difference among themselves whatsoever. Irrespective of the various sources of colostrum (breeds), 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 obtained in the present study uphold the findings of Raimondo et al. (2009) and Bar et al. (2010). Without looking upon at the days of transition, the total plate count of the colostrum samples from different animal sources (breeds) under study was found to have no significant ($p > 0.05$) difference among themselves whatsoever. Irrespective of the various sources of colostrum (breeds), 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).

**CONCLUSION**

The local non-descript animals possessed lower values than Jersey and Jersey cross animals for various physico-chemical, compositional and microbiological characteristics.

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