Biological Forum – An International Journal **14(3): 480-483(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

A Comparative Study on the Quality and Physico-Chemical properties of Bovine Colostrum

N. Sahana[1*], T.R. Pugazhenthi[2], B. Murugan[3], M. Parthiban[4] and M. Prabu[5]

[1]Research Scholar, College of Food and Dairy Technology, Chennai (Tamil Nadu), India.
[2]Professor, Department of Livestock Products Technology (Dairy Science), Madras Veterinary College, (Tamil Nadu), India.
[3]Professor and Head, Department of Food Safety and Quality Assurance, College of Food and Dairy Technology, Chennai (Tamil Nadu), India.
[4]Professor, Department of Animal Biotechnology, Madras Veterinary College, Chennai (Tamil Nadu), India.
[5]Professor and Head, Department of Livestock Business Management, Madras Veterinary College, Chennai (Tamil Nadu), India.

(Corresponding author: N. Sahana)*
(Received 21 May 2022, Accepted 12 July, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: This study was performed to assess and compare the quality and composition of skimmed cow and buffalo colostrum. Studies have indicated that the immune boosting properties of bovine colostrum is beneficial for human beings with no reports of allergic or anaphylactic reactions. Colostrum samples were collected on the 1st and 2nd days after parturition and their quality were assessed using colostrometer. The samples were stored at- 20°C in deep freezer. The frozen colostrum was thawed and defatted using cream separator. Physico-chemical properties such as fat, protein, lactose, ash, moisture, pH and titratable acidity were analysed for the skimmed bovine colostrum. It was recorded that skimmed cow and buffalo colostrum on 1st and 2nd days varied from to 0.65 –1.19% fat, 16.10 –19.25% protein, 2.42 – 2.60 % lactose, 0.77 - 0.84 % ash, 74.69 - 77.79% moisture, 6.16– 6.31% pH and 0.393 - 0.442% titratable acidity. The fat, protein, ash and titrable acidity were found to be decreased as the days advanced. Whereas, the lactose, moisture and pH content were high on 2nd day compared to the 1st day skimmed bovine colostrum. In comparison to the skimmed cow colostrum, all physico-chemical parameters were higher in skimmed buffalo colostrum.

Keywords: Colostrum, Colostrometer, Cream separator, skimmed cow and buffalo colostrums.

INTRODUCTION

Colostrum is the most effective natural immune booster that is known to science. The new born calves are fed with the initial mammary secretion, called bovine colostrum, which is produced within the first 72 hours of parturition. It contains several immunological and growth factors, essential nutrients, trypsin inhibitors, and protease inhibitors to prevent gastrointestinal tract deterioration (Das, 2009). According to Panahi *et al.* (2010), bovine colostrum is similar to human colostrum and are rich in vitamins, minerals, fats, carbohydrates, disease-fighting proteins, growth hormones, and digestive enzymes. Colostrum is known to be crucial for the development of the neonate immune system. The amount of lactoferrin in colostrum is 20-fold greater than it is present in the raw milk (Reiter, 1978). Bovine colostrum has a total immunoglobulin concentration that is around 100-folds higher than that of regular milk (McGrath, 2016). Age, breed, nutrition, and diseases are some of the variables that affect the composition and physical characteristics of an animal (Tsioulpas *et al.,* 2007). Bovine colostrum was incorporated into cream separated to remove fat which in turn increased the concentration of protein. Separation technologies used to produce protein ingredients derived from milk include screening based on size differences *viz*. centrifugation based on density differences; membrane processes based on size differences, such as ultrafiltration, diafiltration, nanofiltration, and reverse osmosis (Huffman and Harper 1999). The deffated colostrum can also be used for the production of any value-added products.

For determining the quality of colostrum, Fleenor and Stott (1980), firstly developed a regression equation to estimate colostral immunoglobulin concentration from the specific gravity of fresh whole colostrum (globulin concentration = 211.4 × (specific gravity - 218.2). The developed colostrometer, which incorporated the relationship between immunoglobulin concentration and the specific gravity into a conventional hydrometer. Although colostrometer readings had a stronger correlation with actual IgG levels, farmers do not frequently use it (Bartier *et al.,* 2015). Vasseur *et al.* (2010) stated that even though producers were aware of the benefits of using a colostrometer, its utilization remains low, possibly due to its fragility and inconvenience of use.

The present study was carried out to evaluate and compare the quality and physico-chemical parameters of colostrum samples collected from cow and buffalo.

MATERIALS AND METHODS

A. Preparation of colostrum

The bovine colostrum of 1st and 2nd days after parturition obtained from the healthy cows and buffalos were procured from the Community Cattle Care Centre of College of Food and Dairy Technology, Koduveli and Livestock Farm Complex (LFC), Madhavaram of Tamil Nadu Veterinary and Animal Sciences University and private dairy farms, Chennai. Post procurement, the colostrum were immediately transferred to the sub – zero(-20°C) condition at deep freezer. The frozen colostrum was thawed indirectly using hot water and defatted using centrifugal cream separator (Mach, Coimbatore) before experimental trials.

B. Colostrometer reading

Colostrometer (Biogenics Laboratories, Mapleton, USA) was used to determine the quality and immunoglobulin content in colostrum.

The colostrometer consists of a measuring cylinder, spindle, and a float, allowing conclusions about the specific gravity due to its displacement. The density correlates with the immunoglobulin concentration in the colostrum. Based on this correlation, the density measured with the colostrometer could conclude the immunoglobulin concentration as shown in the Table 1 (Fleenor and Slot 1980).

Table 1: Correlation of colour and immunoglobulin concentration in colostrometer.

Colour representation	Immunoglobulin level (22°C /72° F)	Days
Green – Superior colostrum	50-140 mg/ml	1-3
Yellow – Marginal colostrum	30-50 mg/ml	4-5
Red – Inferior colostrum	10-30 mg/ml	6-7

Fig. 1. Colostrometer.

C. Determination of physicochemical properties

All the chemicals used in the present study were of analytical grade and procured from HiMedia Laboratories Private Ltd, Mumbai, India. The reagents required for analysis were freshly prepared from chemicals by adopting standard procedures and stored under desired conditions wherever required. The deffated bovine colostrum were analysed for physico-chemical properties such as fat, protein, lactose, ash, moisture, pH and titratable acidity.

The fat content of cream separated skimmed bovine colostrum were determined by Gerber's method as per the procedure outlined in IS: 1479 (Part II) – (1961). The protein, ash and moisture contents of the sample were determinedas described in AOAC (1990). For cream separated colostrum the lactose and pH contents were determined as prescribed in AOAC, 2000. Titratable acidity (percent lactic acid) of the deffated cow and buffalo colostrum were estimated as per the method described in ISI Handbook, SP 18:1981.

D. Statistical analysis

Statistical analysis was carried out to study the effect of different parameters on all the dependent variables. The data obtained were tabulated and subjected to statistical analysis performed using IBM SPSS® 20.0 for Windows® software as per the standard procedure of Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

A. Colostrometer reading of bovine colostrum during first two days after parturition

The colostrometer reading showed decline in values for both cow and buffalo colostrum as shown in Table 2.

Table 2: Colostrometer reading of bovine colostrum during first two days after parturition (Mean ± SE)[@].

Type of colostrum	Days		T value
	1	2	
Cow Colostrum	80.50 ±0.04	76.56±0.70	5.56**
Buffalo Colostrum	95.65±0.03	87.26±0.07	10.98**

Average @ 6 trails Values ** Highly significant (p< 0.01) difference

The mean ± SE values of colostrometer readings were 80.50 ±0.04 and 76.56±0.70 for cow colostrum on the first and second days of parturition, while 95.65±0.03 and 87.26±0.07 for buffalo colostrum on the first and second days of parturition respectively.

From Table 2, a highly significant difference was observed in the immunoglobulins for first two days after parturition in both cow and buffalo colostrum. These results showed that there was decline in second day as compared with first day. It was inferred that the first day colostrum have high immunoglobulin than the second day. The findings of this study were correlated with the guidelines of the colostrometer given by Biogenics laboratory, USA. As per guidelines given by Biogenics laboratory, Green mark indicates superior colostrum which has 50-140mg/ml, yellow mark

indicates marginal colostrum which has 30-50mg/ml and red mark indicates inferior colostrum with 10-30mg/ml IgG. From this, it was concluded that the collected colostrum were of superior quality.

The colostrometer is an on-farm primary method that can be utilized by the farmers to detect immunoglobulin easily than other methods like ELISA and immunoblotting (Bartier *et al.,* 2015).

B. Proximate analysis for skimmed colostrum during different days

The mean ± SE values of the composition of skimmed cow and buffalo colostrum during first two days after parturition were presented in Table 3.

Table 3: Proximate analysis for skimmed colostrum during different days (Mean ± SE)[@].

Attributes (in %)	Cow colostrum			Buffalo colostrum		
	1st day	2nd day	T value	1st day	2nd day	T value
Fat	0.70±0.03	0.65±0.03	1.003^{NS}	1.19±0.08	0.83±0.03	4.055**
Protein	18.74±0.18	16.10±0.10	12.51**	19.25±0.13	18.51±0.16	3.446**
Lactose	2.57±0.11	2.60±0.13	0.204^{NS}	2.42±0.14	2.51±0.13	0.426^{NS}
Ash	0.96±0.03	0.77±0.11	1.69*	1.09±0.06	0.84±0.07	2.61*
Moisture	75.22±0.08	77.79±0.08	29.99**	74.69±0.11	75.19±0.10	9.32**

Average @ 6 trails Values
** Highly significant (p< 0.01) difference
* Significant (p < 0.05) difference
NS- Non-Significant (p ≥0.05)

It was quite evident from Table 3 shows a decreasing trend for fat, protein and ash in first day 0.70±0.03,1.19±0.08; 18.74±0.18, 19.25±0.13; 0.96±0.03, 1.09±0.06, whereas, 0.65±0.03, 0.83±0.03; 16.10±0.10, 18.51±0.16; 0.77±0.11, 0.84±0.07 in second day for skimmed cow and buffalo colostrum respectively. But lactose and moisture content increased from 2.57±0.11, 2.42±0.14; 75.22±0.08, 74.69±0.11 in first day, to 2.60±0.13, 2.51±0.13; 77.79±0.08, 75.19±0.10 in second day for skimmed cow and buffalo colostrum respectively.

In the current study, a significant difference was observed among the composition of skimmed colostrum for the first two days of parturition except lactose which showed non-significant difference. Fat, protein and ash contents showed decreasing trend as the days advanced. Whereas, lactose and moisture contents showed increasing trend on advancement of days in cow and buffalo colostrum. Arain *et al*. (2008) found that an average fat percentage of buffalo colostrum at the initiation of lactation was 5.44%. Colostrum rich in protein on the first day of parturition decreased gradually from second day and attained normal value during the conversion to milk (Ghosh and Anantakrishnan 1964).

Coroian *et al.* (2013) reported that the lactose concentration from colostrum gradually increased after the colostral period and attained the highest values in regular milk. Das (2009) reported that the values for protein content showed a remarkable decrease during the successive milking after parturition.

The day wise report for the composition of skimmed cow and buffalo colostrum showed approximately 1% decline or raise of composition for each day. The result obtained in the current study was in concurrence with the research findings of Parish (1950); Foley *et al* (1972); Sodhi *et al.* (1996) who have also narrated the same trend. Small variations that were observed amongst the findings of different investigators might be due to the differences in methods of analysis, or due to the variation between individual animals and breed.

C. Physico- chemical properties of skimmed colostrum

The physicochemical properties like pH and titratable acidity of both skimmed cow and buffalo colostrum during first two days were shown in Table 4.

Table 4: Physico-chemical properties of skimmed colostrum (Mean ± SE)[@].

Attributes	Cow colostrum			Buffalo colostrum		
	1st day	2nd day	T value	1st day	2nd day	T value
pH	6.16±0.016	6.21±0.014	2.40^{NS}	6.27±0.017	6.31±0.015	1.71^{NS}
Titrable acidity (%LA)	0.495±0.002	0.476±0.001	10.10**	0.415±0.002	0.393±0.001	11.27**

Average @ 6 trails Values
** Highly significant (p< 0.01) difference
NS- Non Significant (p ≥0.05)

From the results (Table 4), there was a gradual increase in pH of colostrum as the days advanced. The pH was 6.16±0.016 and 6.21±0.014 for skimmed cow colostrum and 6.27±0.017 and 6.31±0.015 for skimmed buffalo colostrum respectively for the first and second two days after parturition.

Similar results were observed by McIntyre *et al.* (1952), that the pH of colostrum at parturition ranged from 6.0 to 6.61, with an average value of 6.32 and this value increased with time and reached pH 6.5 after 2 weeks According to McCarthy and Singh (2009), the pH of colostrum was lower than that of normal mid-lactation milk.

The change in titratable acidity was observed to be high in skimmed cow and buffalo colostrum on first day. It was noted as 0.495±0.002 and 0.415±0.002 for first day and 0.476±0.001and 0.393±0.001 for second day in skimmed cow and buffalo colostrum respectively. Titratable acidity of colostrum is roughly 2 – 2.5 times higher than that of milk (Mitjushin, 1979).

Arain *et al.* (2008) reported that titratable acidity of first day milking colostrum as 0.39±0.01% which decreased to 0.34±0.004%, 0.31 ± 0.003%, 0.33 ± 0.01%, 0.30 ± 0.004% and 0.26±0.004% in second, third, fourth, fifth and sixth subsequent milking days respectively.

CONCLUSION

The colostrometer reading result showed that both the cow and buffalo colostrum were of high quality and had good immunoglobulin concentration (50–140 mg/ml). The tested parameters such as fat, protein, lactose and pH were high in skimmed buffalo colostrum than the skimmed cow colostrum, whereas, the ash, moisture and titrable acidity were high in skimmed cow colostrum than the skimmed buffalo colostrum. The pH increased and titrable acidity decreased as the days advanced. Thus, the skimmed buffalo colostrum found to had superior quality than the skimmed cow colostrum.

FUTURE SCOPE

The bovine colostrum has higher protein content with immunoglobulin G compared to normal milk. So the surplus bovine can be skimmed and utilized for the new product development that will deliver the immunoglobulin rich product with long shelf life and consumer acceptability, which also serves as a source of value to the farmers.

Author Contribution. N. Sahana: Conceptualization; Carried out the experiments; Data Acquisition; Investigation; Writing original draft; T. R. Pugazhenthi: Methodology; Resources; Validation; Writing original draft. B. Murugan: Investigation; Validation; Writing – review and editing M. Parthiban: Critical Revision of Publication; Supervision. M. Prabu: Statistical analysis and Interpretation of data.

Acknowledgement. The authors acknowledge the support provided by Tamil Nadu Veterinary and Animal Sciences University, for providing financial support and Department of Food Processing Technology and Department of Food Safety and Quality Assurance, College of Food and Dairy Technology and Department of Livestock Products Technology (Dairy Science), Madras Veterinary College, Chennai for providing the resources to undertake this research work.

Conflict of Interest. None.

REFERENCES

AOAC (1990). Official methods of analysis (15th Ed.). Association of Official Analytical Chemists, Washingtonn DC.

AOAC (2000). Official methods of analysis of AOAC International, (17th Ed.), Gaithersburg, MD, USA: AOAC.

Arain, H. H., Khaskheli, M., Arain, M. A., Soomro, A. H., and Nizamani, A. H. (2008). Heat stability and quality characteristics of postpartum buffalo milk. *Pak J. Nutr*, *7*(2), 303-307.

Bartier, A. L., Windeyer, M. C., and Doepel, L. (2015). Evaluation of on-farm tools for colostrum quality measurement. *Journal of Dairy Science*, *98*(3), 1878-1884.

Coroian, A., Erler, S., Matea, C. T., Mirean, V., Răducu, C., Bele, C., and Coroian, C. O. (2013). Seasonal changes of buffalo colostrum: physicochemical parameters, fatty acids and cholesterol variation. *Chemistry Central Journal*, *7*(1), 1-9.

Das, A. (2009). Studies on chemical composition of colostrum powder (Post graduate dissertation, NDRI, Karnal).

Fleenor, W. A., and Stott, G. H. (1980). Hydrometer test for estimation of immunoglobulin concentration in bovine colostrum. *Journal of Dairy Science*, *63*(6), 973-977.

Foley, R. C., Bath, D. L., Dickinson, F. N., and Tucker, H. A. (1972). Dairy cattle: Principles, practices, problems, profits. Lea and Febiger, Philadelphia, PA.

Ghosh, S. N., and Anantakrishnan, C. P. (1964). Composition of milk. 5. Effect of stage of lactation. *Indian Journal of Dairy Science*, *17*, 17-28.

Huffman, L. M., and Harper, W. J. (1999). Maximizing the value of milk through separation technologies. *Journal of Dairy Science*, *82*(10), 2238-2244.

IS: 1479 part II (1961). Method of test for dairy industry, Chemical analysis of milk, Manak Bhavan, New Delhi, 29: 31.

IS: (SP: 18), (1981). "ISI Handbook of Food Analysis, Part XI: Dairy Products," Indian Standards Institution, New Delhi.

McCarthy, O. J., and Singh, H. (2009). Physico-chemical properties of milk. *Advanced Dairy Chemistry* (pp. 691-758). Springer, New York, NY.

McIntyre, R. T., Parrish, D. B., and Fountaine, F. C. (1952). Properties of the colostrum of the dairy cow. VII. pH, buffer capacity and osmotic pressure. *Journal of Dairy Science*, *35*(4), 356-362.

Mitjushin, V. V. (1979). Dyspepsia in newborn flocks of Moscow. *British Journal of Biomedical Science, 111*: 63-69.

Panahi, Y., Falahi, G., Falahpour, M., Moharamzad, Y., Khorasgani, M. R., Beiraghdar, F., and Naghizadeh, M. M. (2010). Bovine colostrum in the management of nonorganic failure to thrive: a randomized clinical trial. *Journal of Pediatric Gastroenterology and Nutrition*, *50*(5), 551-554.

Parish, D. B., Wise, G. H., Hughes, J. S., and Atkeson, F. W. (1950). Properties of the colostrum of the dairy cow. V. Yield, specific gravity and concentrations of total solids and its various components of colostrum and early milk. *Journal of Dairy Science*, *33*(6), 457-465.

Ranganna, S. (1986). Manual of Analysis of Fruit and Vegetable Products. *Tata McGraw Hill Publishing Company Ltd.* New Delhi. 7-12 and 109.

Reiter, B. (1978). Review of nonspecific antimicrobial factors in colostrum. In *Annales de Recherches Veterinaries, 9*(2), 205-224.

Snedecor, G. W., and Cochran, W. G. (1989). Statistical methods, 8thEdn. *Ames: Iowa State Univ. Press Iowa*, *54*, 71-82.

Sodhi, S., Ahuja, S. P., and Singh, S. (1996). Changes in the levels of ionic calcium and proteins during assembly of casein micelles and transition of colostrum to milk in the buffalo and cow. *Buffalo Journal*, *12*, 101-108.

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*(11), 5012-5017.

Vasseur, E., Borderas, F., Cue, R. I., Lefebvre, D., Pellerin, D., Rushen, J., and De Passillé, A. M. (2010). A survey of dairy calf management practices in Canada that affect animal welfare. *Journal of Dairy Science*, *93*(3), 1307-1316.

How to cite this article: N. Sahana, T. R. Pugazhenthi, B. Murugan, M. Parthiban and M. Prabu (2022). A Comparative Study on the Quality and Physico-Chemical properties of Bovine Colostrum. *Biological Forum – An International Journal*, *14*(3): 480-483.